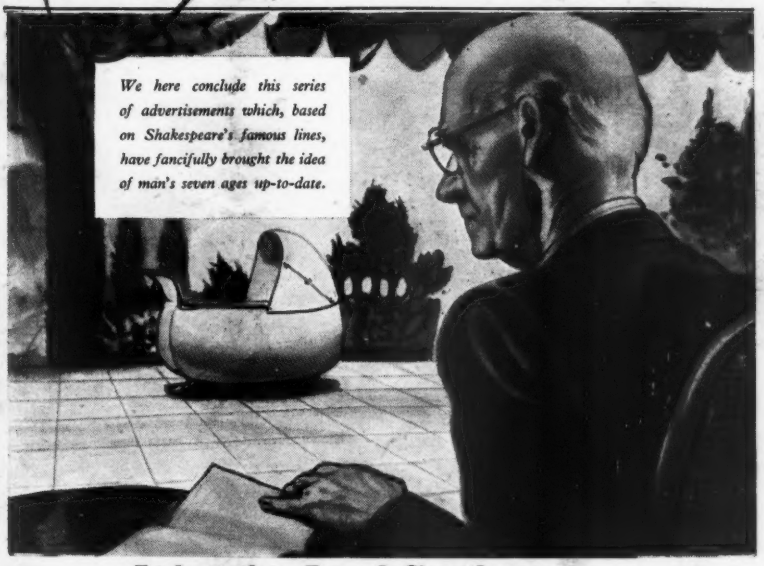
PTEMBER, 1946 ONE SHILLING & SIXPENCE

Plastics

DEALING WITH THE MANUFACTURE, USES AND POTENTIALITIES OF PLASTIC MATERIALS

CHNOLOGY DEPT.

THE SEVEN AGES OF PLASTICS MAN – No. 7


We here conclude this series of advertisements which, based on Shakespeare's famous lines, have fancifully brought the idea of man's seven ages up-to-date.

At last the Aged Gentleman . . .

Full of years, he faces with composure his inevitable departure in a plastics casket. But not yet! He has, he secretly hopes, some years of well-earned leisure to enjoy. Nor is he yet devoid of teeth, of sight, or of hearing; these infirmities are aided by a plastics dental plate, plastics-framed spectacles, a plastics hearing aid. He sits under a fadeproof plastics awning, seated at a garden table which has a stainless plastics top; while beside him sleeps his granddaughter in her plastics perambulator. So the path of his declining years is made smooth and more pleasant by plastics; and by the time to-day's grandchildren are of age, who knows what still-more-wonderful developments plastics research will unfold? We at Erinoid have acquired almost a lifetime's experience of plastics in manifold forms. Our resources and technical service may help to smooth your path to plastics manufacturing success.

Erinoid LIMITED

MANUFACTURERS OF MODERN PLASTICS MATERIALS

CELLULOSE ACETATES • PHENOLIC RESINS • POLYSTYRENE
LAMINATED MATERIALS • VINYL RESINS • CASEIN MATERIALS

ERINOID LIMITED, LIGHTPILL MILLS, STROUD, GLOUCESTERSHIRE

MARCO RESIN

for LOW PRESSURE MOULDINGS

Invitation
We take pleasure in announcing the manufacture of SB Marco Resins at our Wollaston Works.
These resins enable large size articles to be produced on small and simple machinery, reduce tool costs to a minimum and permit laminated sheets to be made by continuous process.
We invite you to send for full details.
R.S.V.P.
109 Kingsway

SCOTT BADER & CO. LTD.

109 KINGSWAY, LONDON, W.C.2.

TELEPHONE · HOLBORN 3691 (3 LINES)

WORKS – WOLLASTON

IN QUALITY & SERVICE — SB — FOREMOST

SYNTHETIC RESINS

PRODUCTS :

"XYLONITE" (*Celluloid*)

"BEXOID" (*Cellulose Acetate*)

BX P.V.C. (*Polyvinyl Chloride*)

"DISTRENE" (*Polystyrene*)

"LACTOID" (*Casein*)

BX ETHYL CELLULOSE

"ISOFLEX" (*Lightweight Thermal Insulation*)

BX PLASTICS LIMITED

LARKSWOOD WORKS · LONDON, E.4

Telephone: Larkswood 4491

Branch Offices:
King Street Buildings,
1 Ridgefield, Manchester 2
Telephone :
Manchester Blackfriars 0258

42 Wellington Street, Sheffield
Telephone : Sheffield 25517

Works :
London. Manningtree.
Dundee.

TAYLOR TX 812

★Forge saves 800 tons of coal a year; increases production

An example of what THERMAL LINKAGE can do ★

What is Thermal Linkage? It is a proved, practical method of getting maximum work from total heat supplied. In brief, Thermal Linkage integrates your various heat-using processes and, as far as possible, operates them as a single co-ordinated heat-using unit. Instead of being independently supplied directly to separate consumption points and the surplus from each going to waste, heat is circulated and re-circulated to extract from it the last ounce of work.

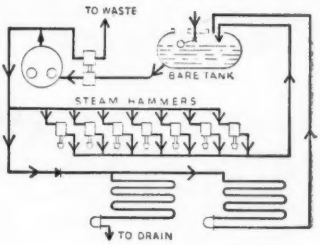
★Capital outlay recovered in 13 months

THE PROBLEM: 14 x 10 cwt. steam hammers installed in two shops: 7 in constant use, demanding 5,000 lb. of steam per hour over a 58-hour week; additional 3,000 lb. of steam an hour for space heating; 700 lb. per hour lost through leakage. Boiler needed 40 tons of washed trebles per week during winter. 2,000 lb. of condensate per hour ran to waste.

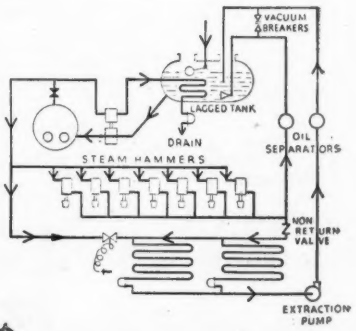
ACTION TAKEN included detail improvements in boiler plant and steam transmission. Steam pressure at hammers reduced from 100 to 80 p.s.i. and foot controlled cut-off valves installed. Feed pump exhaust taken through a coil in feed tank. Most of space-heating load carried by exhaust steam without interfering with hammer operation. Surplus exhaust sent to hot well. Condensate return system installed. Only 5,300 lb. of steam required. Rough smalls substituted for washed trebles. 800 tons of coal p.a. saved. Production increased through not having to stop hammers owing to shortage of steam. Capital outlay (£1,904) recovered in only 13 months.

For complete description see "Fuel Efficiency News," September, 1945

BEFORE



AFTER



Consider this NOW

Whether or not you are reconstructing or reconverting your plant, consider this question now:—What economies can Thermal Linkage achieve in your plant?

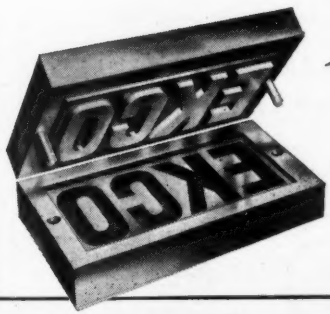
FOR GENERAL INFORMATION, see *Fuel Efficiency Bulletin* No. 21.

FOR SPECIFIC ADVICE, contact the Regional Office of the Ministry of Fuel and Power.

ISSUED BY THE MINISTRY OF FUEL AND POWER

If it's a job for Thermosetting Moulding—
Ekco can do it!
If it's not—
Ekco will tell you so!

EKCO has the "know-how" on Moulded Plastics



Ekco know the possibilities—and the limitations—of the Thermosetting Moulding process. You can consult Ekco with perfect confidence that you will get expert impartial advice on *your* moulding job.

Ring Regent 2601 or Southend-on-Sea 49491—and get the benefit of Ekco's wealth of experience.

Moulded Plastics for Industry

E. K. COLE LTD., PLASTICS DIVISION, DEPT. P, 5 VIGO STREET, W.1
Works: Southend-on-Sea, Essex.

Tullis Russell & Co. Ltd.

Makers of

BASE PAPERS

for the

PLASTICS INDUSTRY

•

AUCHMUTY & ROTHES PAPER MILLS

MARKINCH, SCOTLAND

LONDON
1 Tudor Street, E.C.4

MANCHESTER
372 Corn Exchange Buildings
Corporation Street

BIRMINGHAM
116 Colmore Row

Reg'd. Trade Mark

Pioneers of History

William Caxton, born 1422. Died 1491. Printed the first book on English soil in 1477, thus opening the gateway to knowledge for countless millions — a pioneer of History indeed!
We too, can claim to be pioneers in Plastic moulding and place at your disposal a vast amount of knowledge gained in the hard school of experiment and experience.

Bring your moulding problems to us. All enquiries treated in the strictest confidence.

ROBERT McARD & CO. LTD.
CROWN WORKS • DENTON • MANCHESTER

Pioneers IN PLASTIC MOULDING

LEAD

WHITE LEAD
RED LEAD
ORANGE LEAD
LITHARGE
SULPHIDES OF ANTIMONY
WHITE METALS

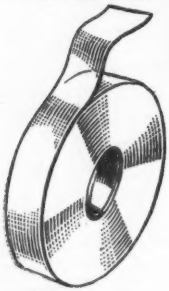
Supplies of Lead and Antimony Products are available for essential (defined) purposes.

Also
Other Low Melting Point Alloys in Ingots, Castings and Extrusions.

ASSOCIATED LEAD MANUFACTURERS LTD
embracing
Locke, Lancaster and W. W. & R. Johnson & Sons Ltd. • Walkers, Parker & Co., Ltd.
The Cookson Lead and Antimony Co., Ltd. • Foster, Blackett & James Ltd.
The Librex Lead Co., Ltd. • The London Lead Oxide Co., Limited.
14, FINSBURY CIRCUS, LONDON, E.C.2 • CRESCENT HOUSE, NEWCASTLE-ON-TYNE • LEAD WORKS, CHESTER

ALM

431 INDUSTRIES ALREADY USE INDUSTRIA



Sticks at a touch!

SELF ADHESIVE TAPE

For wrapping, for sealing, for masking, for protection, for riveting, for joining, for identification . . . . . in dozens of ways INDUSTRIA is helping manufacturers to save time, to save money.

Can we help you? Please do not hesitate to ask for free sample rolls and illustrated brochures, or for any advice we can give about the application of self-adhesive tapes to your needs.

INDUSTRIA self-adhesive tapes in cellulose, cloth or paper.

INDUSTRIAL TAPES LIMITED

92/94 NEWMAN ST., LONDON, W.1. Telephones: MUSEUM 4215 & 8246/8

P.4

YOU CAN'T STOP A MAN WITH A GOOD IDEA

'Sorry, Captain — see you next trip. Had a brainwave — why not use plastics?—simply must see what Lorival say about it!'

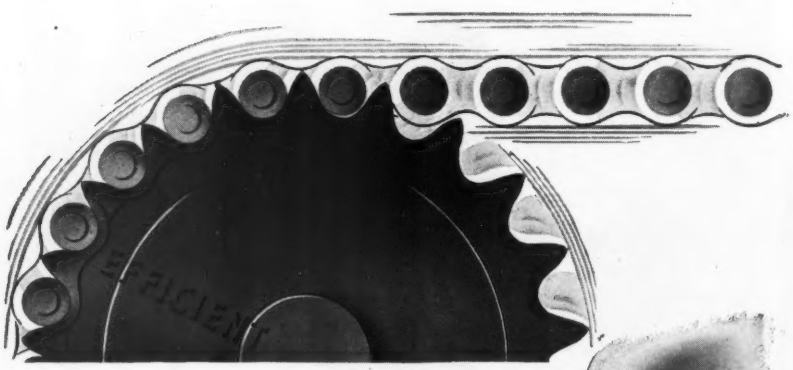
★ *Manufacturers who are considering the design of plastic components, complete articles or packagings, are invited to get in touch with us. Our service includes consultation, design and manufacture in plastics, rubber and synthetic rubbers.*

LORIVAL PLASTICS

U E L

UNITED EBONITE & LORIVAL LIMITED

LITTLE LEVER, NEAR BOLTON, LANCS



POWER TRANSMISSION

by RENOLD

Transmission and Con-eying Chains, Wheels and Accessories for all mechanical purposes

R&CC THE RENOLD & COVENTRY CHAIN CO. LTD. · MANCHESTER · ENGLAND

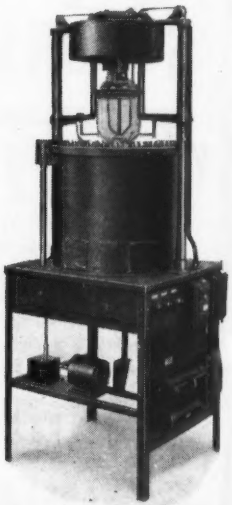
Test for FASTNESS TO LIGHT with the

KBK FUGITOMETER

which incorporates the practical results of many years' research in the FADING OF MATERIALS when subjected to the combined effect of LIGHT and HUMIDITY.

Many changes have been made in this latest model, and here are THREE of the outstanding improvements:

- The samples are mounted on a steady revolving cylinder rotating round the standard light source.
- All samples are subjected to the same degree of humidity and exposure.
- Access to samples under test is easy—without disturbance of humidity conditions.



KELVIN · BOTTOMLEY · AND · BAIRD · LTD.
HILLINGTON · GLASGOW · S.W.2.

for pumps and problems

Hydraulic engineering has its own particular problems for the engineer, problems which differ greatly according to the size and type of installation.
We, who have designed and built hydraulic pumps and specialised control valves for many years, are able to offer service and advice rich in the wisdom of our long experience and research.

ANDREW FRASER
& CO. LTD.

SPECIALISTS IN
HYDRAULIC PUMPS AND VALVES

ASTOR HOUSE, ALDWYCH, W.C.2
'PHONE: HOL. 2995/6. 'GRAMS: MONORAD, ESTRAND, LONDON

Avoid

INDUSTRIAL DERMATITIS

by using

Sternocleanse

No. 1
protects against
PAINT, GREASE, SPIRITS OIL, Etc.

Supplied in 12 x 2 lb. tins and 6 x 7 lb. tins.
Also 28 lb. and 1 cwt. kegs.

For abnormal conditions special grades can be supplied.

No. 2
protects against
WATER-WET SOLUTIONS (SOLUBLE OILS), CHEMICALS, Etc.

STERNOL LTD. · FINSBURY SQUARE · LONDON, E.C.2

Telephone: MONarch 3871-2-3-4-5.
Telegrams: "Sternoline, 'Phone, London."

All enquiries to be addressed to INDUSTRIAL SPECIALITIES Dept. 92

PRESSURE VESSELS

WITH PATENT QUICK OPENING DOORS

for the
PLASTICS INDUSTRY

STEAM JACKETED PANS, AUTO-CLAVES, HEATERS, CONDENSERS, ETC. OF WELDED CONSTRUCTION.

EDWIN DANKS & CO. (OLDBURY) LTD.

OLDBURY, Near BIRMINGHAM Phone: Broadwell 1381 2 3 London Office: 32 FARRINGDON STREET, E.C.4

PERMALI

Laminated
Impregnated
Densified

OUTSTANDING for STRENGTH

HARD WEARING · NON-HYGROSCOPIC

•

IMPACT STRENGTH, 5·5 ft.-lb.

•

TENSILE STRENGTH, 28,000 p.s.i.

•

COMPRESSIVE STRENGTH, 30,000 p.s.i.

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SPECIFIC GRAVITY, 1·28

•

DIELECTRIC CONSTANT (50~), 4·5

PERMALI

Reg'd. Trade Mark

The NEW INSULATION CO. LTD.,
GLOUCESTER (ENG.)
TELEPHONE 4941

designers

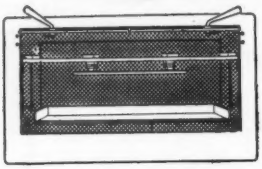
Write for Data Booklet 29B, giving Electrical and Physical Properties and Mechanical Characteristics of this extremely useful material.

9213

EXPORTS INCREASED

through use of RADIO HEATING

PLASTICS manufacturers are now finding that the best way of producing the vast numbers of articles required for export is to step up the capabilities of their presses by using Redifon radio pre-heating.



The standard heating chamber for use in the plastics industry in conjunction with Redifon Model R.H.7 1½ kW radio heater.

This heating method, which heats the powder or preforms all the way through simultaneously, produces such an advanced and even state of flowability when the material is placed in the press, that not only will the press close quicker but less pressure will be required.

Redifon radio heating can not only cut moulding cycles by over 50% but also almost double the usefulness of existing presses.

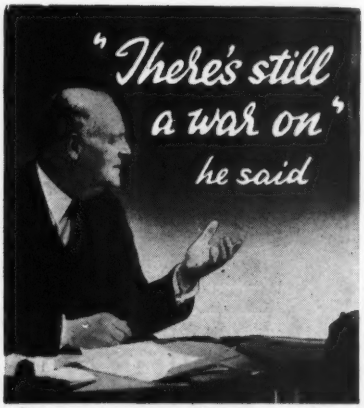
Further details of the use of Redifon radio heating are contained in Rediffusion Technical Bulletin No. 4, which will be forwarded on request.

REDIFFUSION LTD.

Designers and Manufacturers of Radio Communication and Industrial Electronic Equipment

(SUBSIDIARY OF BROADCAST RELAY SERVICE LIMITED)

CARLTON HOUSE, REGENT ST., S.W.1



"There's still a war on," he said. "War on all the time — against a thousand-and-one things; and, not least of all, against the natural laziness of man which tends to leave things to chance and let them take their course.

"You have seen the biggest war of all time won on planning. That same planning is essential to *your* business if you want the same assurance of success.

"You've heard of Pluto?" he suddenly demanded.

"Of course, I've heard of Pluto," I said. "The amazing pipe-line that carried . . ."

"Exactly! . . . that carried the life-blood far and wide to the engines of war.

"Well, have you ever thought that *your* organization is a miniature Pluto?"

I'm afraid I looked at him rather blankly.

"Think of it this way," he suggested. "Your Production is a pipe-line through which you must keep uninterrupted flow, watching and checking for kinks and leaks and stoppages. Your Sales flow is another pipe — more intricate this time. For, whilst your Production flow is in your factory, there under your eyes to watch over and control, the sales flow is an underground pipe coming only to the surface at distant points throughout the country.

"It's no easy matter, you'll appreciate, to find leaks in an underground pipe. It needs planning and control. And, mind you, a sudden burst of energy and a sales boost won't put wrong sales-figures right. Applying pressure to a leaky pipe only increases the loss . . ."

A clever analogy, I thought; and I'll tell you that by the time that fellow had finished talking, he'd made me think quite a lot . . .

★ ★ ★

Has this got your interest sufficiently to want to know all he said? Send 1/- for the booklet mentioned herein. It will be the best disbursement of petty cash your business ever made. Send to Dept. P.3 Kardex Visible Control Systems, 1-19 New Oxford Street, London, W.C.1. Tel.: Chancery 8888.

Booklet by A. R. JACKSON

PLANNED SELLING

KARDEX DIVISION OF Remington Rand Ltd.

TURN IT ROUND AND ROUND AND ROUND BY HAND AND IN THE END THE SCREW GETS HOME. BUT, LUMME MISTER, FANCY SCREWING IN THAHSANDS AND THAHSANDS OF 'EM BY HAND ALL DAY WHEN THERE'S A POWER TOOL THAT DOES 'EM IN A JIFFY

DESOUTTER BROS. LTD. (Dept. S.), The Hyde, Hendon, London, N.W.9. Telephone: Colindale 6346-7-8-9.
C.P.C. 164

NOW ABOUT– BEAUTY AND PRECISION

If your plastic moulded part calls for beauty of design and colour or is for an engineering product governed by precision limits, plastic mouldings will meet these widely differing requirements.

BUT you should always invite the co-operation of Specialists in the initial stages of the design. Advice is also necessary regarding the type of plastic best suited to the characteristics of the job and data on the most economical and time saving methods of production.

Crystalate's long experience and high reputation for service to their Customers make an approach to them worth while for the clarification of all plastic moulding problems.

THEREFORE GENTLEMEN YOU SHOULD CONSULT

CRYSTALATE

PLASTIC MOULDERS & TOOLMAKERS SINCE 1899

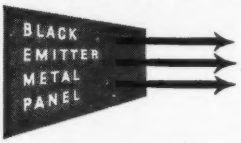
Crystalate Ltd., Golden Green, Tonbridge, Kent.
Phone : Hadlow 233/4/5 (20 lines)

RADIANT HEAT

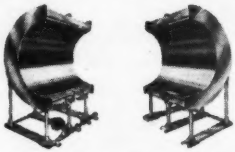
(infra-red)

DRYING

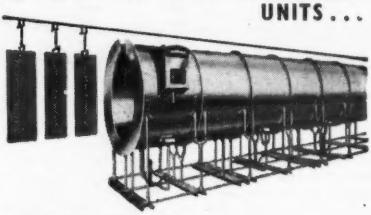
TAKE A SOURCE OF RADIANT HEAT...



USE IT IN A UNIT LIKE THIS...



EQUIP IT WITH GAS-FIRING AND ASSEMBLE TO FORM EXTENSIBLE UNITS...



AND YOU GET THE SIMPLE INFRA-RED DRYING TUNNEL

Robust, compact, inexpensive . . . easily constructed in different shapes and sizes without complicated auxiliary apparatus . . . giving even distribution of radiation and wide range of flux density at the turn of a tap . . . no material difference in drying time due to colour . . . low capital and fuel costs. Technical literature free on request.

FOR SIMPLICITY

the choice is **GAS**

BRITISH GAS COUNCIL
1 GROSVENOR PLACE · LONDON SW1

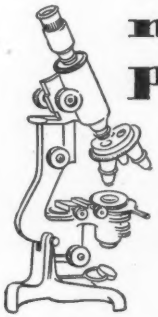
DIE STEELS *for* PLASTIC MOULDING

The ESC folder, reference PLM.1/2, contains details of steels eminently suitable for present needs.

New steels, however, are being designed to meet the special problems arising out of the rapid development in the Plastics Industry.

ENGLISH STEEL CORPORATION LIMITED

OPENSHAW MANCHESTER



mouldings to precision limits

KENT, fine-limit, moulding is opening up a new medium for the precision engineer—wherever plastic components of high accuracy are demanded, there will you find the mouldings of KENT.

KENT MOULDINGS
PROPRIETORS HOLSTED BRANDES LIMITED
Footscray, Kent
Telephone: Footscray 3333

For mouldings that matter

Specialized Instruction *for* PLASTICS WORKERS

is offered by the International Correspondence Schools, the creative pioneers of technical training by the postal method.

Men wishing to take full advantage of the wonderful opportunities offered by a new great industry should write for a copy of our

Special Booklet on "Plastics"

which gives particulars of

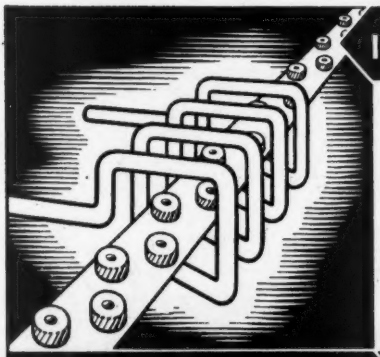
Two new I.C.S. Courses, Plastics and Engineering Plastics

These Courses include the composition and properties of Plastics, manufacturing equipment, tools and processes, and the applications of Plastics in engineering.

INTERNATIONAL
CORRESPONDENCE SCHOOLS, LTD.
Dept. 224, International Buildings, Kingsway, London, W.C.2

I.C.S.

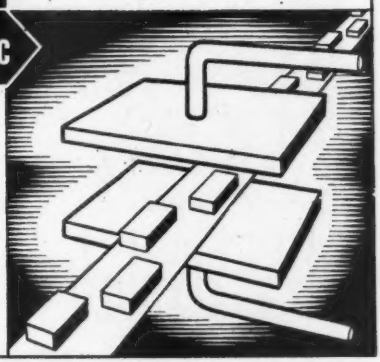
G.E.C.
HIGH FREQUENCY HEATING



INDUCTION

- BRAZING
- HARDENING
- MELTING

DIELECTRIC



- GLUEING
- PLASTIC HEATING
- DRYING

G.E.C. engineers are at your disposal to advise on applications of High Frequency Heating.

Generators range from 100 watts output to 25 kW. output.

Advt. of The General Electric Co. Ltd., Magnet House, Kingsway, London, W.C.2.

PAINT TO BE CUT BY THIRD

News Chronicle Reporter

BECAUSE starving Europe urgently needs more linseed oil for cattle food, supplies to paint manufacturers are to be cut by nearly 30 per cent. from August 21.

This step to be announced by the Food Ministry and the Board of Trade in mid-August, means a virtual ban on paint repair work to "non-essential" property. Retailers will get only the smallest trickle of paint.

For essential work

An official of the Paint and Varnish Manufacturers' Association told me: "We have been warned that our supplies of linseed oil will be so severely curtailed that we shall only have paint enough for re-housing and work on prefabricated houses.

"Private householders who want to paint their front doors and window sills will have to convince their local council and the Board of Trade that the work is absolutely essential."

BE INDEPENDENT OF PAINT

The development of Metal powders during the war years has resulted in spraying by the Schori process, of all kinds of metallics and non-metallics, with the ease and speed of paint spraying. Base metals, such as steel, iron, etc., woodwork, stone, plaster, can be given decorative effects of copper, bronze, aluminium and many plastics, whilst at the same time being protected against corrosion and decay. The Schori powder process bonds all metallics and non-metallics to the

PROTECT AND DECORATE

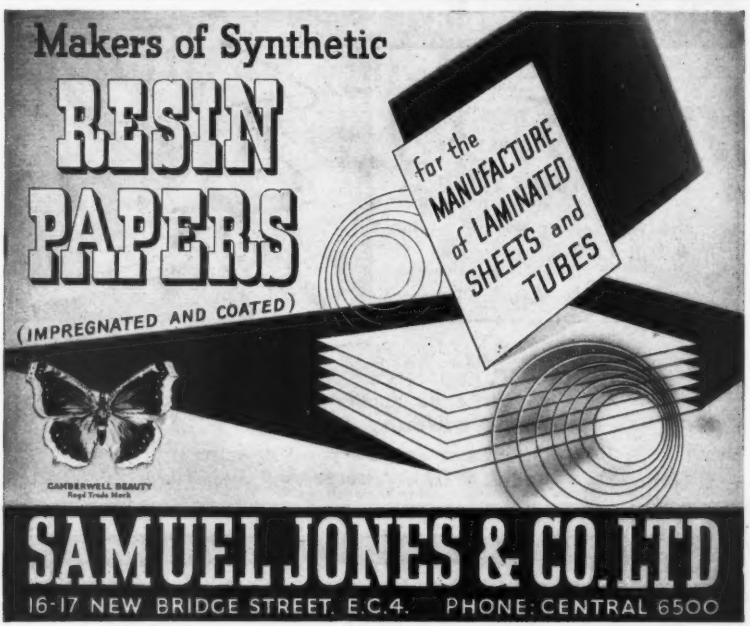
parent surface, thus providing a covering that will not chip, crack or flake; a surface that will last indefinitely, thus reducing costly repetitive labour charges, and expensive renewal of protective coverings. Zinc, lead, aluminium, synthetic rubber or polythene, to name a few of the fifty odd Schori finishes, are in greatest demand for protection against the elements and acids. Decorative finishes in many colours are obtained by such plastics as Thiokol, polymerized shellac, ebonite,

WITH A BONDED FINISH BY

sulphur, etc., all of which, because they are applied in powder form without solvents, can be sprayed to any thickness. *A Zinc sprayed surface forms a perfect key for painting, prevents rust creeping under the surface, and increases the life of paint tenfold. Approved by the Admiralty, War Office, Crown Agents, etc. Licensees throughout the Country.*

Schori METALLISING PROCESS LTD

SCHORI METALLISING PROCESS LTD., BRENT CRESCENT, NORTH CIRCULAR ROAD, LONDON, N.W.10 phone: ELGAR 7393


Makers of Synthetic
RESIN PAPERS
(IMPREGNATED AND COATED)
for the MANUFACTURE of LAMINATED SHEETS and TUBES
CAMBERWELL BEAUTY
Regd Trade Mark
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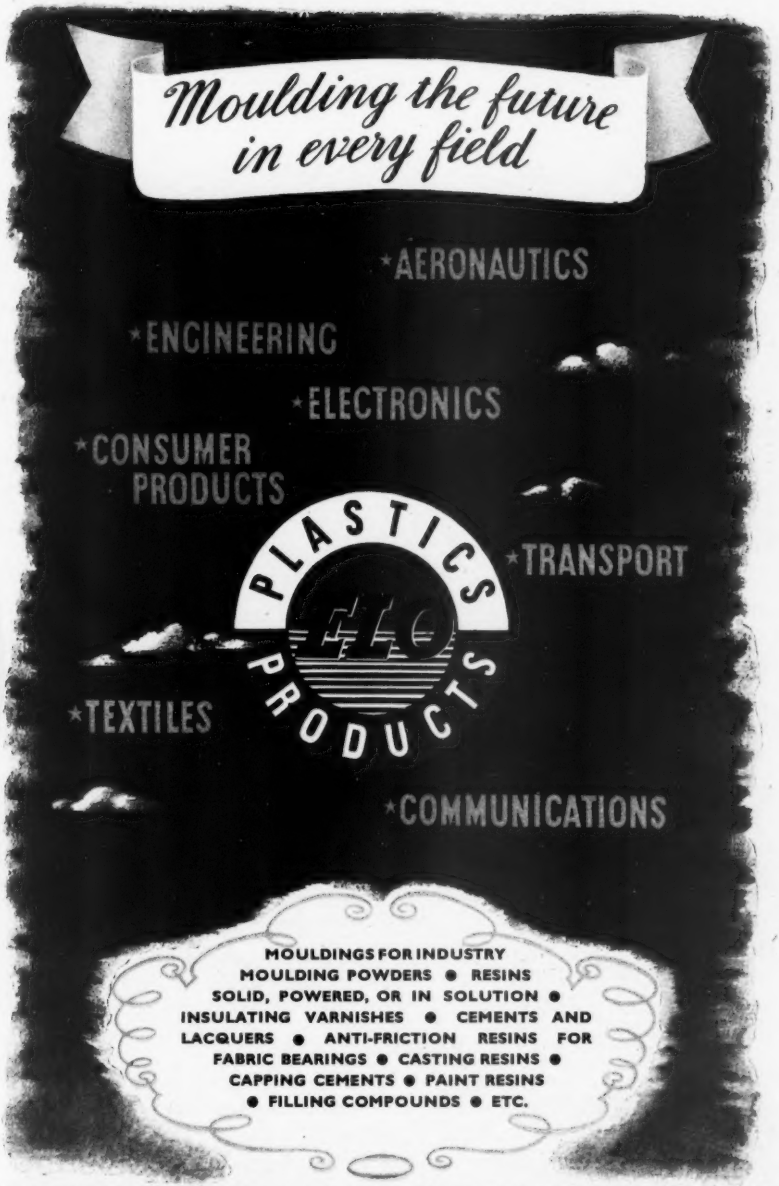
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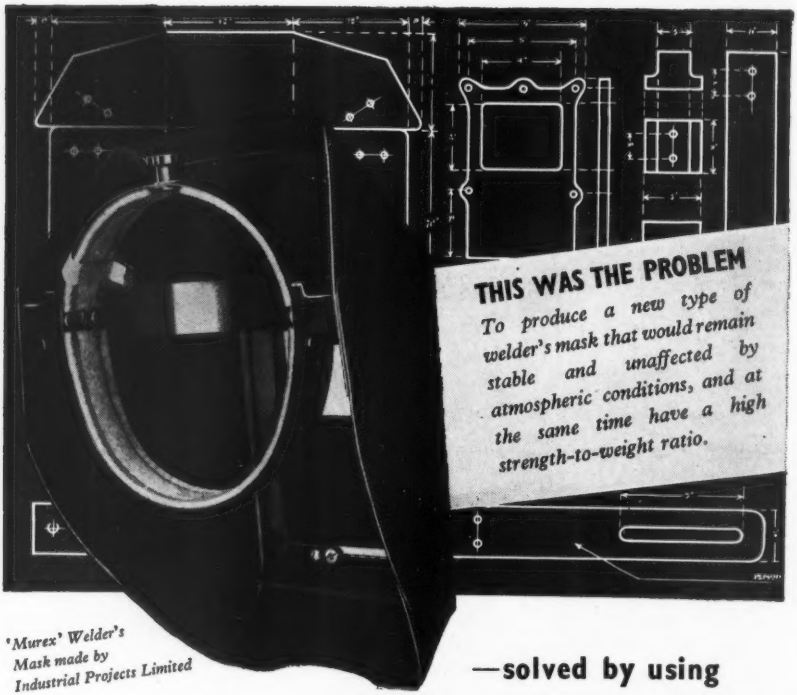
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Plastics

Dealing with the Manufacture, Uses and Potentialities of Plastic Materials

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Editor - - M. D. CURWEN, B.Sc., A.R.I.C.
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NOTICES

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EDITORIALS

Chemicals from Wood

OUR recent remarks on the possibility of utilizing phenols that have not previously been employed for making plastics brings also to mind the more or less complete disappearance of wood distillation, and, in consequence, of a source of chemicals of British production which would be very welcome at this particular juncture of shortage of raw materials. It is well known, for example, that all phenols are short, with little hope of rapid increase in production, and that there is a growing world demand not only for plastics, but also for disinfectants and in many other uses. We all know, too, that urea, formaldehyde and wood flour are in like condition.

The case of formaldehyde reminds us that synthetic methyl alcohol (from which formaldehyde is made) and synthetic acetic acid made from molasses, killed stone dead the industry of wood distillation which flourished up to the 1920s in this country and the U.S.A. The advantages of the new synthetic chemical industry were obvious, since cheaper products in enormous quantities were thus available, and economically it was impossible for the wood distillation industry to stand up to the competition.

The new development, or, rather, the disappearance of the old, however, brought sundry disadvantages. Charcoal, which was one of the most important of the by-products of wood distillation, disappeared almost entirely from British manufacture, and what was made was produced at a much higher cost. Also, much had to be imported from abroad, where those wood distillation factories also found no outlet for their chemicals. During the war, however, the Government, finding that charcoal was a rare commodity here, and needing it so widely for explosive and pyrotechnic purposes, installed a large number of small stills in the Cornish and Devon forests. Presumably, these have now been relegated to the scrap heap.

One wonders what has happened during the war years to the great wood distilling factories in Sweden, Yugoslavia, Poland and Czechoslovakia. Certainly in Germany, where vast quantities of synthetic chemicals were made, they would have little chance of existence under normal circumstances.

Shall we ever again see wood chemicals, wood creosote, Stockholm tar as commercial products in bulk?

We cannot answer this question, of course, except, perhaps, for this country, where our forests are minute and seem destined to be the property of the National Trust, and where reafforestation is only beginning.

In France and the U.S.A. the problem is being seriously considered, and in the former country, indeed, wood distillation is being resuscitated in a very active way. In Great Britain it seems clear that wood distillation as a useful industry is not even being considered, and, indeed, we presume that it has been completely forgotten.

In France, intensive chemical engineering research has been carried out and a new continuous plant has been evolved by a Government-controlled body equivalent to our Fuel Research Board. This plant, it is hoped, will so cheapen production as to make the process truly economic in the face of existing competition. At present efforts are chiefly confined to the manufacture of charcoals of special character, such as activated carbons, which are especially useful for the recovery of benzole from gasworks and of other solvents. Eventually, complete studies of wood tar will be made. A number of the continuous ovens have

already been set up in the Bordeaux district.

In the U.S.A., where wood distillation is also in a very parlous condition, a new attack is being made on the problem purely from the point of view of new chemicals from wood tar. Fractionation of them by means recently adopted in the petroleum industry may give a new life to a moribund industry. Theoretically, at any rate, acids, amines, aldehydes, ethers, hydrocarbons, phenols and ketones, many of them entirely new to industry, are possible.

There's Nothing Like Leather

INDEED there isn't, and however man may contrive, it can be admitted quite freely that he will never simulate closely the mass of tightly knit fibres that go to make up the structure we call skin and hide and which on treatment yield leather.

This universally used material with a tradition almost as old as *Homo sapiens* himself and even to-day bound up with superb artifice and craftmanship, is held in such esteem in its own field as no other known raw material of construction with the possible exception of the precious metals.

Yet we need not deceive ourselves that we shall never produce a material to replace it nor even to surpass it for the purposes it is used. While we may admit that, like beer, there is no bad leather, but only good leather and superlative leather, yet it must be admitted there are degrees of goodness in it. Much rests on the source, on the manner of storing and shipping, and, lastly, on the tanning. It is, after all, a natural protein complex, subject to the attack of putrefying bacteria prior to receiving its protective treatment; furthermore, all skins and hides are subject to wastage in cutting and some parts are better than others for specific purposes.

It would seem, therefore, a legitimate field for the scientist and especially the chemist to attempt to produce a material in which all these disadvantages are absent. He cannot, and indeed he need not, produce a material exactly like it. He should, however, produce, and has tried to produce, a sheet that resembles leather in outward appearance, that is strong and flexible and possesses that curious property known as "soft feel." There are many other desirable properties known to the expert, who is the final arbiter, but the above will suffice for our purpose.

How far have we gone towards this desirable goal?

The matter has always been one of plastics, even though the effort of simulation is much older than the plastics industry so called, and indeed if we choose, since it is composed of such large molecules and probably formed by extrusion, leather may be considered as being made from plastic substances.

The earliest efforts that were produced by man, if not to imitate leather at least to replace it for some of its uses, was the production of oiled cloth, and, if we may include it, linoleum, made by coating fabric with linseed oil combinations.

A much closer attack came with the introduction of the so-called "imitation leathers" generally made by the union of fabric and nitrocellulose lacquers and similar tough films. Indeed, such "leathers" have made a worthy name for themselves, being of great beauty, strength and flexibility, and deservedly find an important outlet for decoration and upholstery in the household and in the automotive industry.

In the field of shoe and boot manufacture, leather has remained, to all intents and purposes, unassailed. Here, there is one property possessed by leather that has not yet been achieved successfully in any man-made material—the property of being able to transmit air across its mass and yet to retain its waterproofness. We can obtain the waterproofness easily enough in synthetic sheets, but not the "breathing" properties.

Rubber has long served and will continue to serve an excellent purpose in the manufacture of waterproof shoes and

boots, while polyvinyl chloride, of even better appearance and less elasticity, is finding considerable outlet for uppers. But none finds ready acceptance as a replacement for sole leather, since none is able to "breathe." It may be that this unique property will always escape us.

The above thoughts come to our mind on viewing what we think to be the closest approach to leather with regard to other properties we have yet seen. It is a new polymer, or perhaps we should say, combination of polymers which in sheets 10 to 15 thousandths of an inch thick we have been quite unable to tear with our hands. This is no fabric combination, but the pure cast transparent polymer, and at this thickness must be stronger than leather. It is flexible and soft and "lives" in the sense that after distortion it is smoothed back to its old shape as does leather. It can receive an impression by hot pressing to simulate any skin, such as crocodile, shagreen or pig. It possesses the great disadvantage of not yet being on the market.

Decorations on Plastics

THE description, in the August issue, of a plastic vanity case made in France and hand-painted by a French artist, brought us evidence of somewhat similar work in this country and also some criticism of decorating an already beautiful material.

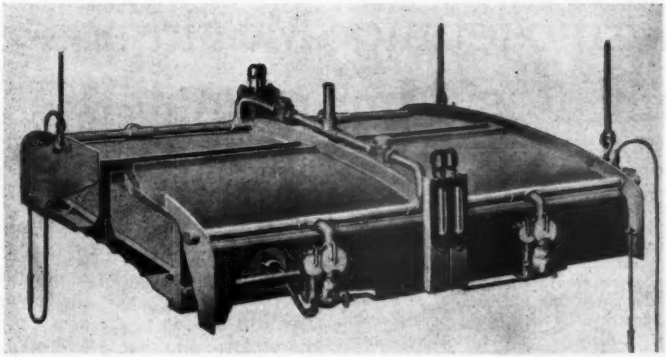
Artists here are now turning their hand to painting in oils on a number of plastics, more especially on trays made of phenolic resin or of methyl methacrylate and cellulose acetate. Almost invariably the latter are painted on the reverse where the decoration is not so easily rubbed or otherwise spoiled. Black trays obviously generally need a colourful design, but it is strange to meet them sprayed on the upper side with a light-coloured paint or lacquer. Obviously the use of a "urea" resin tray would obviate the need for an additional spray, but we admit that a light-coloured tray with a black base and black edge is very attractive. Coupled with a beautiful painting of roses or orchids, the effect is excellent and is selling well in London stores.

Criticism of decoration of plastics is not new. Most moulders and fabricators, and, indeed, many of the artist-designers first in the field, were desirous of laying down as an axiom that plastics, if they were well designed, derived their beauty from the shape and that additional decoration in the form of paint was merely gilding the lily. While there is much truth in this, there is also considerable truth in the fact that additional work spent on a mass-production job raises the cost of the article out of all proportion to the original price. There is also the fact to face that plastics are not always very amenable to applied finishes which in consequence have not the permanence of the plastic base. This latter criticism is perhaps of considerable importance.

On the whole, however, it is somewhat foolish to deny that decorations are a valuable addition to plastics, just as wood or glass or any of the classic raw materials, so beautiful in themselves, can be further embellished by exterior addition.

Single colours may be beautiful, but a number may be more so, and the great disadvantage of plastics, if disadvantage it is, lies in the fact that so far no moulding has yet been produced on a large scale with more than one colour. Attempts to do so have been made in the past, particularly in Germany, but it would seem that the game was not worth the candle. Similarly, considerable use was made of the production of a depressed design in the moulding, the depression being filled with coloured wax or other composition.

One of the most effective methods of ornament was that of introducing metal "filigree" work which was placed on the bottom of the mould, the powder then being moulded round it, so that the design was firmly fixed. The effect was often beautiful, but the adoption of the process was not strongly supported by the public, for obviously the result was not cheap.



RADIANT HEATING FOR CURING P.V.C.-COATED TEXTILES

THE curing of textile materials which have been coated with polyvinyl chloride for imparting waterproof and crease-resisting qualities may be carried out by a recent application of radiant heating using gas-fired radiant heating panels. In this connection, the use of gas is advantageous, because long-wavelength radiation can be produced which enables materials of all colours, together with black and white, to be processed in practically the same time. The curing times, moreover, are short; they vary between ½ min. and 3 mins., at a panel temperature of 650 degrees F., depending on the weight and thickness of material.

The heating panel consists of a row of gas burners firing into a combustion chamber, on one side of which is the hot radiating panel and on the other side an insulated backing block to retain the heat. The heater is made up of two units, the complete radiating panel measuring 56 by 41 ins., with 32 No. 0 industrial jets firing horizontally on each of the long sides. The radiating surface is specially designed with overlapping, dish-shaped, mild-steel sections to prevent buckling due to the relatively large unsupported area. A baffle plate of heat-resisting steel is fitted to the inner side of the radiating panel for a distance of 8 ins. from the burners to smooth out the temperature distribution. The insulation consists of Newall's asbestos, 3 ins. thick, faced with ¼-in. asbestos sheet.

The panel can be heated to its full operating temperature in about 15 mins. by using a high gas rate. Under test, this was achieved by using 1.26 therms of gas an hour with a gas pressure of 3¼-3½ inches w.g. However, it is undesirable to heat the panel continuously at this gas rate, as the type of insulation normally fitted is designed for a panel temperature of 650 degrees F. This temperature is adequate for p.v.c. curing operations; higher temperatures tend to cause scorching. Indeed, the gas rate may reasonably be cut down after 15 mins.

Tests have been made on curing fabrics coated with polyvinyl chloride in which material coated with both black and white plastic was run underneath the panel at a temperature of 650 degrees F. and at a distance of 3¼ ins. from the edge and 5½ ins. from the centre. The fabric cured successfully at a rate of travel of approximately 2¼ ft. per minute. Other lighter fabrics have been cured at a rate of up to 10 ft. per minute.

This horizontal black-emitter radiant heat panel has been designed by the Gas Light and Coke Company.

Thermosetting Mouldings from Resin-impregnated Pulp

The author of this article describes the production of mouldings from resin-impregnated pulp by depositing a preform on a gauze conforming to the shape of the article it is desired to produce, using a suspension of fibres and resins, with subsequent moulding. The technique offers many advantages over existing methods, including the use of lower pressures and cheaper moulds. It gives products with excellent tensile and impact strengths, and uses less resin.

By William S. Penn, B.Sc.

THE importance of the technique of producing mouldings from pulp impregnated with resins cannot be too strongly emphasized. All but neglected on a production scale in this country, the method may well augment the normal moulding technique which is at present prevalent throughout the plastics industry. This statement mainly applies to the larger and thicker type objects and those employing synthetic thermosetting resins.

Although it is possible to make radio cabinets and similar objects by the normal moulding technique with standard moulding powders, the required tonnage of the press may be high. In addition, employment of non-impact powders gives products of relatively low impact strength; if impact powders are used, this involves the use of very high tonnage and very expensive moulds. With resin-impregnated pulp, using the "preform technique," no matter what size or thickness of moulding it is possible to employ pressures less than 1 ton per sq. in., and also non-ferrous metal moulds. This technique, moreover, is independent of supplies of moulding powder; the manufacturer virtually makes his own moulding powder, from either home-produced or purchased resin, and he does that more cheaply than if buying ready-made moulding powder. Additionally, it is possible to produce large-size mouldings having impact strengths equal to the best of the "shock powders."

Briefly, the method consists in producing a dispersion of fibres, almost invariably in water, roughly forming these into the shape of the article by a felting process, it is desired to produce, compacting the preform and drying and moulding it, the bulk factor of the preform often being as high as 5 to 1. It is also necessary to incorporate the resin at some point.

In doing all this, great care and judgment has to be made in certain matters, among which are:—Choice of fibre; consistency of pulp dispersion; pH of the dispersion at various points; type of coagulant; point of incorporation of resin; temperature of dispersion; modification of the dispersion engine (i.e., the beater) and degree of beating; type of resin and size of molecules; nature of mould for preforming; consistency of dispersion while forming; degree of drying the preform; moulding conditions, etc.

Pulp Equipment

Before discussing the process in detail,

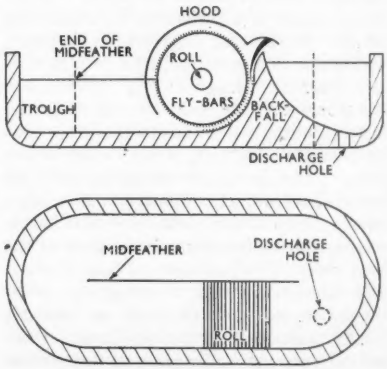


Fig. 1.—General construction of beater as used in paper-making.

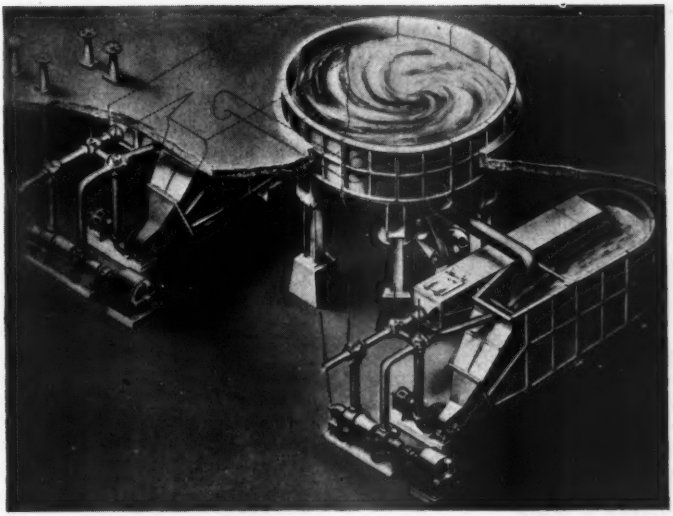


Fig. 2.—Special type of "hydrapulper" and beater. (Fraser (London) and Co., Ltd.)

it will be well to describe some of the pulp machinery which is needed. Since pulp from wood is most commonly employed in making preforms this is the type referred to throughout this article unless otherwise stated.

There are two main objects of beating (a) to shorten or fibrillate the fibre, (b) to hydrate the fibre. This process is accomplished in a machine termed a "beater," which consists of an oblong tub or trough (made of cast iron or concrete), having at the centre a wall or "midfeather," which does not reach to the ends of the trough. The construction will be easier understood by reference to Fig. 1. In this machine the dispersion of pulp is circulated by means of the cast-iron roll driven mechanically, out of which protrude a definite number of rods termed "fly-bars." Partly following the curve of the roll is the "bed-plate," which also has protruding bars. It is between the bed-plate and roll fly-bars that the pulp is beaten or dispersed. The raised section of the floor at the back of the roll is called the back-fall, and it definitely helps in promoting circulation with consequent higher quality of the fibres produced. Additionally, the floor of the trough is shaped to avoid lodgments of pulp. These are the main features of the beater. A special type of hydrapulper and beater is also illustrated. (Fig. 2.)

Among other items of pulp equipment required are "stuff" chests and "stuff" pumps, "stuff" being the term often applied to the dispersion of pulp. The stuff chest is merely a means for storing the dispersion of pulp, and consists of a large tub fitted with an efficient agitator. The stuff pump is a special type of centrifugal pump for moving the stuff from one operation to another by way of pipework.

Preparing the Dispersion of Fibres

There are two main points at which it is possible to incorporate the resin. It may be added at the beater stage, followed by coagulation upon the fibres; alternatively, the preform may be incorporated with a solution of the resin. The advantages and disadvantages of the two methods will be discussed later, but for the present it will be assumed that the resin is added at the beater stage.

It is most unlikely that plastic manufacturers would make their own pulp, which conveniently can be bought in the form of sheets or laps, to be cut up and added to the beater in which water is circulating. The substances added to the beater are called the "furnish," and the percentage of pulp to water is referred to as the consistency or density. Normally this consistency should be between 5 and 7 per cent.; the higher the better,* although the ability of the beater to take this imposes limitations here. Beating is continued from one to five hours, the actual time depending on the degree of hydration required and being spoken of as "the slowness." Obviously, the longer the fibres are beaten, the more hydrated they become. For making plastic mouldings, it is best to have a "very slow" stuff; beating for three hours is recommended.

Incorporation of Resin

The resin may be added at any time during the beating operation, usually between 15 minutes from the start and 30 minutes from the end. It may be added as a fine powder (100 mesh) or in form of emulsion; if the former, the resin should be added to the beater through a screen. There has been much controversy as to which is the best method, but both give results more or less equal. The powder method is the most convenient. Emulsions, however, may be stored in large quantities for long periods of time, provided they are suitably stabilized, and certainly give an even dispersion throughout the fibres.

Towards the end of the beating, the resin has to be deposited on the fibres. This is done by coagulation. The usual coagulating agents, such as alum, may be employed, but it is better to commence with sodium aluminate and finish off with aluminium sulphate; in this way frothing is avoided. The temperature will rise automatically during the beating operation, but 60 degrees C. gives about the best results.

The control of pH during the beating operation is very important.* At the commencement of the operation the "furnish" should be slightly alkaline and the pH should be made and maintained (for at least three-quarters of the beating) at about 8.0. When actually furnishing, pH conditions in the beater should be as near 7.0 as possible. During coagulation the "furnish" becomes slightly acidic and the pH should be maintained between 5.6 and 6.0.

Implications of Beating

On the control of the beating operation depends the success or the failure of the pre-forming operation. It is, therefore, important to have an extensive knowledge of the beating operation; time spent on pulp technique is far from wasted.

The two main objects of beating are to cut and hydrate the fibres. Beaters are so designed that any amount of cutting or slowness can be given to the fibres. In the case of plastic preforms, it is hydration and not cutting which is required. Some cutting is unavoidable, but this should be kept at a minimum. Practical results of the effect of varying fibre length are given in Table 1. Reduction in length of fibre causes a reduction in physical properties, particularly tensile and impact strengths.

Table 1.—Effect of Fibre Length on Strength of Mouldings, Phenolic resin, 45 per cent., with Kraft pulp.

Moulding pressure, 1 ton per square inch.

Length of fibre, mm. ..	3.40	3.21	1.59
Compressive strength (edgwise), lb./sq. inch) ..	27,600	26,700	22,600
Impact strength (Izod) ft.lb./inch of notch	3.15	2.81	1.23
Tensile strength, lb./sq. inch	11,300	9,300	8,000

The maximum "slowness" is required of the pulp. This actually helps to improve the finish of the completed mouldings and, additionally, it gives good retentivity of the resin by the fibre. It will be appreciated that the latter point is important, for during the actual beating operation itself, and subsequently, resin is

* Throughout the article an asterisk indicates ideas and methods which are the subject of patent applications.

likely to be detached from the fibres unless care be taken. The retentivity of the resin by the fibre is never 100 per cent.; only 70 per cent. is attainable, and this must be allowed for.

The slow "stuff" is obtained in several ways, some of which have already been mentioned. The higher the consistency, the slower the stuff. The design of the beater is also important, and a few words may be said about this with advantage. The tub should be large and the backfall 12 to 18 ins. above the centre-line of the roll. The hood over the roll should be long and high. The number of cutting edges of the fly bars, etc., should be reduced to a minimum, but the area should be increased as far as is possible.*

The peripheral velocity of the beater roll can vary a great deal, but is frequently about 2,200 ft. per minute. At the commencement of beating, the roll should be well raised from the bedplate (0.120-0.150 in.), but during three-quarters of the cycle it should be slowly lowered to about 0.01 in. from the bedplate. Slowly lowering in this manner helps to give a "slow stuff" with consequent advantages. If the roll is lowered quickly, the pulp is relatively free (i.e., opposite to "slow") and is unsatisfactory for pulp/resin mouldings.

During the next one-eighth of the cycle the roll may be lowered a further 0.004 in. and the resin added. After this the roll can be brought down to as low as 0.0035 in. Incidentally, the roll should never be raised during the beating cycle. The maxim to bear in mind is "light roll pressure for a slow stuff." The control of pH is important and assists materially in giving good retentivity; it can be made automatic with suitable instruments.

Storing the Dispersion

It will be appreciated that preparing dispersions of fibres is essentially a batch process, but is used continually and the process must be made continuous. The "furnish" from the beater is discharged through a hole in the bottom of the beater to the "stuff chest," which is generally capable of holding the capacity of two beaters. The beater is washed out with water, and this causes dilution of the "furnish" to a consistency of about 3 per cent. At this stage, and during subsequent dilution, the pH should be maintained between 5.6 and 7.0, this being best for subsequent preforming.

The dispersion for making the preforms is drawn from the "stuff chest" which is replenished every time a beater discharges its batch. Storage in the "stuff chest" improves the slowness of the "stuff," although this is not usually possible owing to the rapid turnover required. In any case, efficient agitation should always be maintained in the "stuff chest" and anywhere else where the dispersion is likely to stand.

The Preform Operation

When the dispersion of fibres has been prepared, it is possible to proceed with making the preform. The special preform mould (to be described later) is immersed in the suspension of fibres, and suction is applied to its under surface. Water is thereby drawn through the preform mould and the fibres are deposited on the surface as a "felt," conforming to the shape of the mould. This preform is then removed, compacted if desired by a bag method, and dried.

The Preform Mould

The mould is usually made in two parts. First, there is a non-ferrous metal tool conforming as accurately as possible to the shape of the article it is desired to produce. This is drilled all over with a plurality of holes, each about 3/32 in. diameter. This tool is then covered with a wire gauze (75-85 mesh), likewise conforming to the shape of the article it is desired to produce. In this form the mould is ready for making the preforms.

Non-ferrous metals (usually bronze) may be safely employed, since little pressure is exerted; such metals are relatively cheap.

Making the Preform

The remainder of the equipment used for making the preform may be either static or dynamic. That is, the preform

mould may be fixed stationary in a tank and surrounded by the suspension of fibres whenever necessary. Alternatively, the mould may be fixed to a press, and be continually dipped into the suspension of fibres.* The former is relatively simple and is the one described here.

For the preforming operation, the dispersion is diluted to a consistency of 1 to 2 per cent. (maintaining the correct pH). The tank containing the mould is then filled up to such a level that the desired weight of pulp and resin is deposited on the mould when the level of the dispersion reaches the bottom of the mould. Upon the application of vacuum to the under surface of the mould, the preform is formed. With this operation being possible in as little time as 30 secs., it will be appreciated that production can be high. If trouble is experienced with forming, the temperature may be raised.

When forming deeply drawn objects there is a tendency for the preform to be thinner at the edges. This applies particularly where there are heavy concentrations of resin, but methods of overcoming the use of large quantities of resin are to be described. To overcome this edge effect, the bronze tool has to be modified. Larger holes at the edges will help; the back drilling of holes is also important. Incidentally, the preform mould should be of even thickness.

Dilution to 1 to 2 per cent. can be carried out in tanks, prior to introduction to the preforming tanks. As this would involve large dilution tanks, dilution is most conveniently carried out in the preforming tank itself.

When it is required to vary the thickness of any one moulding, this can be readily accomplished (B.P. 560,475) in the following manner:—The tool and gauze are made in the normal manner, as if the preform was to be the same thickness all over. The preforming operation is then commenced and continued until the part of minimum thickness has been built up. Preforming is then temporarily discontinued, and the parts which have already been built up to the correct thickness are covered with thin sheets of some material. During the whole of this time the vacuum is maintained and the thin sheets are thus held in place. Preforming is now continued and those parts which have not been covered up receive further layers of fibres. In this manner any variation in thickness may be built up; there is no weakness at the point where the wall was temporarily held up.

Compacting and Drying the Preform

The preform at the end of the above operation is very " soggy " and contains a great deal of water. A high vacuum should be maintained for a short time, as this helps to remove some of the water. The preform is then usually rigid enough to be taken from the preform mould by hand, compressed air being applied if necessary to loosen it. The bulk factor of this preform is high, being 5 to 1 or more. Covering with a thin rubber sheet and applying vacuum will compact it somewhat and, at the same time, remove further quantities of water. The process is designed very much along the lines of the bag-moulding technique.

Before moulding, the preforms should be dried to about 7 per cent. moisture content. This may be done in the usual type of drying oven with air circulation. Wooden formers may be needed to stop the preforms warping, but this is usually unnecessary. Ordinary drying, with the preforms stacked one on top of the other, is often quite satisfactory, although the process is more efficient if they are kept separate. Other implications of this drying are considered later, in connection with the use of solvents. Fig. 3 shows the usual type of continuous dryer.

During the actual forming the vacuum need not be too high, although it can be increased to any extent during the compacting. The drying operation may be used to bring the resin to an advanced state of cure. However, this may be carried out separately, particularly if the preform is impregnated with resin, after drying. High-frequency heating can be used with these preforms, as with normal pellets; much, however, depends on the shape of the preform.

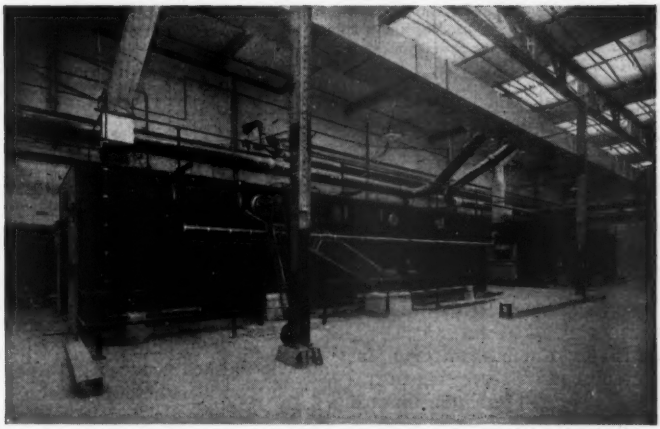


Fig. 3.—Continuous-type dryer for the pulp industry.
(Tomlinsons (Rochdale) Ltd.)

The temperature of drying varies according to the resin used; a good average figure is 50 degrees C., but this may be increased, subject to great care being taken not to cure the resin. The lower temperatures allow a preform with a constant moisture content to be obtained, which is important.

The Moulding Process

The moulding process does not differ substantially from any other, except that it is frequently possible to employ non-ferrous dies and low-tonnage presses. After being brought to the furthest state of cure which it is possible to obtain outside the press, the preform is placed in the heated mould in exactly the same way as a normal moulding powder. In this form it would roughly follow the contours of the mould. The press is then closed, but opened again after the lapse of a few seconds; two or three subsequent breathing periods are also given. This follows the methods adopted during normal breathing operations.

At the end of the curing time the press is opened, but no particular advantages are gained by cooling the moulding, which can be removed hot, without trouble, although if blisters should appear cooling will help to avoid them.

The curing time depends on the type of resin employed and the precure given to it. It can be brought down to four or five minutes, no matter what the size of the object, which can be deep drawn and have a large area and still be cured rapidly. There is a negligible amount of flow in the mould. The pressure is required merely to compact the preform and hold it in place during cooling.

So far as dies are concerned, the type of metal used will depend on the pressure employed. This will be discussed later, after several other points have been cleared up, particularly that of the point of incorporation of resin. With pressures up to 300-400 lb. per sq. in., non-ferrous metals, such as bronze or zinc, may be used. At pressures greater than this steels are needed, the hardness depending on the pressure. Non-ferrous moulds may be used even with the largest mouldings, provided the pressure is not above 400 lb. per sq. in.; there is little danger of warping or distortion. The reason for this is that no flow is necessary, thus minimizing the wear on moulds.

The processes so far outlined work out well as a mass-production, continuous operation. If the resin were made on the

Table 2.—Properties of Beater Treated or Impregnated Preforms, both containing .45 per cent. Resin and Cured under Same Conditions.

	Tensile strength lb./sq. inch	Impact strength ft. lb./inch of notch	Water absorption %
Preforms with resin added at beater stage	16,000	4.07	0.6
Preforms impregnated after forming	11,300	3.02	0.2

premises (as it very well might be), this would mean the production of mouldings complete from the original raw materials.

Method Incorporating the Resin

The way in which the resin is incorporated into the preform has an important bearing on subsequent processing operations and the quality of the finished product (Table 2).

The mechanical properties of products of the beater dispersed type are better than those of the impregnation type. The water absorption, however, is poorer; additionally, the surface appearance is not so good. These differences are always obtained. Less pressure (often half as much) is needed in the case of the impregnated type.

In the impregnation method, the resin really penetrates the fibre structure and is continuous. Such a moulding will be relatively brittle, but will resist the penetration of water and give a good resin film on the surface. In the case of the beater dispersed resin the resin is discontinuous; this allows for flexibility, but it is bad for water absorption.

A careful choice of the method to be employed has to be made. Where water absorption is not so important, the beater-dispersed method is the one to adopt. There are also considerations of available pressure, convenience and surface appearance. These are discussed later, where a means of combining the two operations is dealt with.

Aspects of Impregnation

The solvent employed is one of the important considerations of the impregnation method. If solvents other than water are used, the problem of solvent recovery may arise. Alcohol soluble resins are frequently employed, and the question of recovery or not is one of economics for individual manufacturers. However, water soluble resins are also available. The use of water or alcohol again involves differences in the quality of the finished product and it is important to consider these differences.

Water, being a highly polar solvent, penetrates the fibres and carries the resin well into the fibre structure. Good water absorption and dimensional stability is thereby obtained, although (for similar reasons to those outlined in the previous section) the impact strength is low. With alcohol, which is not such a highly polar solvent as water, the resin is only carried to the surface, and this results in good impact strength but poorer water resistance.

Dryness of the Preform

Another aspect of water/alcohol or other solvent is connected with the degree of dryness of the preform. With water the preform need not be dried to such a great extent, since this can be done after the resin has been incorporated. In the case of other solvents the drying must be fairly complete—at least, with those solvents which are immiscible with water.

One point in favour of the solvent method of impregnation is that these resins are more advanced in their state of cure than the water soluble types, but this is not a great advantage considering that the resin may be precured before going into the mould.

Resin Content

As in any other types of plastics, the resin content is very important, due to its influence upon properties. Table 3 (R. U. Hastanger and R. H. Mosher, " Modern

Table 3.—Effect o (Resin Content on Properties of Pulp Plastics.

Resin content	Tensile strength lb./sq. inch	Impact strength (Izod) ft. lb./inch of notch	Water absorption % 24 hours
55	13,400	1.09	0.42
45	13,500	2.72	0.64
35	12,600	4.80	0.82
25	12,600	6.64	24.3
15	12,200	6.96	70.6

Plastics," 1943, **20**, 11) shows the effect of varying the resin content.

In these tests Kraft pulp was used, and the test pieces were moulded at 880 lb. per sq. in. and 320 degrees F. (phenolic resins). It is readily seen that the impact strength increases a great deal with decreasing resin content. This is what would be expected, since the brittleness is continually being reduced. Tensile strength is affected little, but, unfortunately, the water absorption increases a great deal with decreasing resin content. The optimum resin content has to be chosen, and this is usually about 35 per cent. resin content, at which figure all properties are quite satisfactory.

Two other effects of the resin content must be mentioned. First, it is difficult to obtain a high resin content, due to troubles of retentivity. Secondly, a high resin content causes difficulties with forming. On the other hand, a high resin content gives good surface hardness, good appearance, and good resistance to moisture absorption. In view of these various statements, it is obvious that there are advantages and disadvantages of high and low resin contents. A method of combining the two will be described later.

It is possible to use a much smaller percentage of resin in preform pulp plastics than in conventional moulding powders, and still maintain good properties.

Pressures Used

It can be stated quite definitely that only very low pressures are needed to make the mouldings. Contact pressures are quite sufficient, and 200 lb. per sq. in. gives quite good results. As far as tensile strength and impact strength are concerned, very little difference in results is obtained, whether the pressure be 200 or 2,000 lb. per sq. in. However, this is not the only consideration. The higher the pressures, the better the surface appearance.

If surface appearance is of no importance (and this applies also to hardness and water-absorption), pressures as low as 200 lb. per sq. in. may be employed. If these properties are to be enhanced, the pressure must be increased. Good results are obtained at about 1,600 lb. per sq. in.; it is rarely necessary to go above one ton per sq. in. This will immediately raise a comment from users of conventional moulding powders, who will say: "We can mould ordinary moulding powders at one ton per sq. in., so what is the advantage of using this new process?"

It is true that small mouldings can be made at one ton per sq. in., into which province, incidentally, the preform method does not claim to intrude. However, in the case of the larger mouldings, it is not usually possible to work at such low pressures as this. In addition, even provided one ton per sq. in. can be used, the impact strength of these products is very low. Then, it may be said, employ high-shock powders. Of course, this can be done, but pressures far greater than one ton per sq. in. are required.

On the other hand, with the preform method, no matter what the size of the moulding, the maximum pressure which need be employed is one ton per sq. in., and this also gives products with high-impact strength, good water-resistance, hardness, and surface appearance. The choice between 200 lb. per sq. in. and one ton per sq. in. moulding of the preforms is dependent upon the difference existing between non-ferrous and steel moulds.

(To be continued)

PLASTICS FROM COAL-GAS CONSTITUENTS

IT is anticipated that the next few years will see a considerable extension of the manufacture of materials from coal-gas constituents, which will be of interest to the plastics and synthetic rubber industries. Prospects of this were outlined in a paper which Dr. N. Booth, principal scientific officer to the Gas Research Board, read before the Institution of Gas Engineers at their annual meeting in London, in June, and since published as Communication No. 294.

A great chemical industry has grown up in America based on the utilization of refinery gases from the petroleum industry. In Britain, the available amount of refinery gases is small, but similar gases derived from coal being available, it appears that an almost parallel industry covering the manufacture of organic chemicals will be built up here through the medium of these gases. Already, in December last, Imperial Chemical Industries announced a plan for the production of heavy organic chemicals from coal on Tees-side in a plant estimated to cost £10,000,000. The gases of immediate importance are ethylene and propylene, the former for the manufacture of polythene, cellulose acetate, and methacrylic acid. Dr. Booth considers that in erecting plant for the recovery of ethylene and propylene, the carbonization industries should be at no disadvantage as compared with alternative methods of ethylene production. At the present time no less than 360,000 tons of ethylene and 100,000 tons of propylene should be available annually in Great Britain.

Ethylene derived from coal gas after separation by liquefaction as part of an integrated scheme might be available at 2d. per lb. as compared with 6d. per lb. from other sources. Processes for the manufacture from ethylene of at least 50 chemicals could be undertaken if the market demand were found to be adequate. These include the synthetic rubber, "Buna S," of which American production is already 850,000 tons annually. This rubber is manufactured from butadiene and styrene. The two liquids are mixed and emulsified, using an emulsifying agent. They are then passed through a number of reactors maintained at about 45 degrees C. A different catalyst is used in each reactor and total reaction time is about 30 hours. The latex is then subjected to steam distillation to remove unreacted material.

Styrene can be manufactured entirely from products of coal carbonization by taking ethylene and benzene in the ratio of 2:1 and mixing them at atmospheric pressure and 90 degrees to 100 degrees C. in the presence of aluminium chloride. In this way ethyl-benzine is produced which, after purification, is dehydrogenated to give styrene. The latter process is carried out at about 600 degrees C. and atmospheric pressure in the presence of an excess of steam of 1.25 to 1.5 parts by weight. A complex catalyst consisting primarily of zinc oxide, but also containing oxides of aluminium, calcium, potassium and sometimes chromium, is used. The walls of the reaction vessel are lined with special metals (e.g., copper-manganese) to prevent cracking effects. The styrene is purified by vacuum distillation.

Butadiene has been made in Germany from acetylene, and in the United States either from butanes or butenes made from cracking of petroleum oil, or from ethyl alcohol. It is clear that butadiene can be made from ethylene by conversion to alcohol followed by dehydration and dehydrogenation. In Russia the last two stages are carried out in a single stage by passage of the alcohol vapour over a mixture of aluminium and zinc oxides.

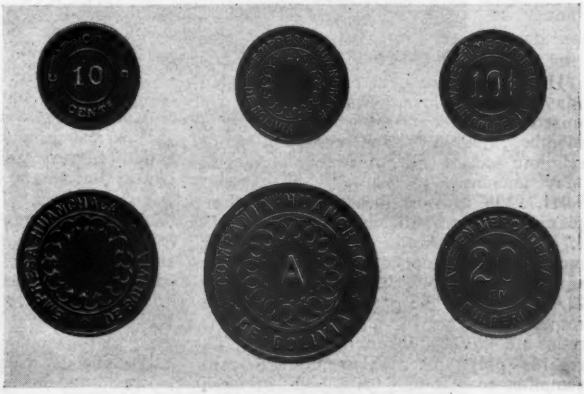
Styrene has been manufactured abroad for some years for use in the plastics industry, for example in making polystyrenes. Its present cost in the United States, based on ethylene at £33 per ton and benzene at £12 per ton, is £37 per ton. In Great Britain the price is about £110 per ton. Cost figures are not available for butadiene made from ethylene, but, made from petroleum, it costs about £42 per ton in the United States.

MONEY TO BURN

And Money That Will Not Burn

WE have received from a traveller in Germany samples of the new plastic coinage issued by the War Office to the British Forces in occupation. They are of small denomination, one penny and one halfpenny, and with the threepenny paper note seen above are valid only for transactions within official canteens.

With these limitations the arrangement bears little resemblance to a general currency, so that, in contradiction to what has been stated in the daily Press, this is not the first occasion on which plastic coins—or, rather, tokens—have been made and used in this country. They were quite common, of course, during the



Ebonite coins or tokens made in England for Bolivia. They were almost always used locally on the large estates to be spent at local stores.

war in British Restaurants and elsewhere.

The interesting point about the present ones is that they have been stamped from laminated material, the top and bottom sheets of which are printed with the amounts 1d. and ½d. We doubt that they are anything but temporary expedients, for they are deep brown in colour, and merely came into being because of lack of metal. The sheet is of the normal phenol-formaldehyde resin-impregnated type.

The British Restaurant tokens were made, we believe, by moulding phenolic urea resins and cellulose acetate, and were much more pleasing to handle.

Contrary to general opinion, money, or rather tokens of it, made of non-metallic substances are not new.

Some of the earliest examples were made in Leyden in 1574, when the town was beseiged by the Spanish forces. The authorities issued a 30-sol piece stamped out of thick parchment. The coin was quite rigid, heat probably being applied during the stamping process, and bore the figure of a lion and crown on the obverse and the arms of the city on the reverse.

Coins stamped out of leather and cut from horn are also quite well known.

Coming to a more modern times, as early as 1909 a Co-operative Society in the East of England experimented with the use of moulded celluloid token pieces. They were issued to customers for the purpose of crediting dividend due, replacing discs for various values previously made of metal. They were manufactured by the British Xylonite Co. at Brantham, near Manningtree, Essex. Similar token coinage is still being made by Halex, Ltd., a subsidiary of the British Xylonite Co.

True coins of celluloid were also issued during the early part of the 20th century in Chile during political disturbances, and were similar to those tokens used by the Chilean railways in 1909. One of these was quite picturesque, the one-peso piece being milled, 1½ ins. in diameter, red on one side and black on the other. The inscription showed it was issued by the municipal authorities of Antofagasta.

Tokens in plastic materials have, indeed, been long common in the Latin American States, where much use of them was made by the large estate owners for distribution among the peasant workers, as in Bolivia, where, strangely enough, much of the world's copper is mined. These were obviously for local consumption, since they bear, in addition to the value (say 1 boliviano, 10 cents, etc.), the inscriptions "vale en mercaderias," "vale en pulperias" and "asiento," meaning valid in shops and local stores belonging to the estate owners themselves. These tokens were made of ebonite by one of the large rubber companies in this country.

Plastics Consumption in America

United States statistics for plastics during May (the latest month available) showed a mixed trend as compared with the preceding month. Shipments and consumption of cellulose acetate and mixed ester plastics in May amounted to 8,894,870 lb., against 9,041,752 lb. in April, those of nitrocellulose plastics at 1,532,407 lb., compared with 1,714,961 lb. in April. Phenolic and other tar-acid resins shipped and used in May amounted to 22,017,432 lb., compared with 21,460,925 lb. in the preceding month. The respective figures for urea and melamine resins are 4,630,030 lb. and 4,513,352 lb. As regards polystyrene, shipments and consumption rose from 4,950,626 lb. in April to 5,159,798 lb. in May. Vinyl resins fell from 10,749,058 lb. in April to 10,626,080 lb. in the following month.

According to a recent industrial survey, the current production rate of industrial and decorative plastic laminates in the United States is 50 per cent. above the pre-war record level. The increase is attributed to an easing of raw material shortages and increased plant capacity; demand, however, still exceeds supply, the greatest problem confronting laminators being the difficulty in obtaining fillers and backing materials. New uses to which plastic laminates are being put include elevator panels, taxicab interiors, kitchen tables, counter and sink tops, and door panels.

FASHION PLASTICS

for the Ultra

EXTRUDED

THE SKIRT IS INTENDED AS A SUN-SUIT AND EXTRUDED P.V.C. STRIP WIDE BELT.

MAILED BLOUSE

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ORIGINAL DRAWINGS AND SPECIFICATIONS FROM THE PLASTIC RESE

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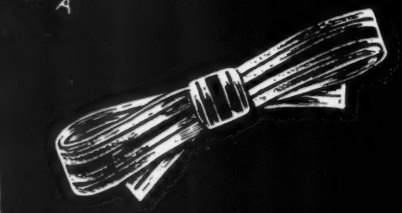

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OLOURFUL STRIPES. WHICH EFFECT CAN
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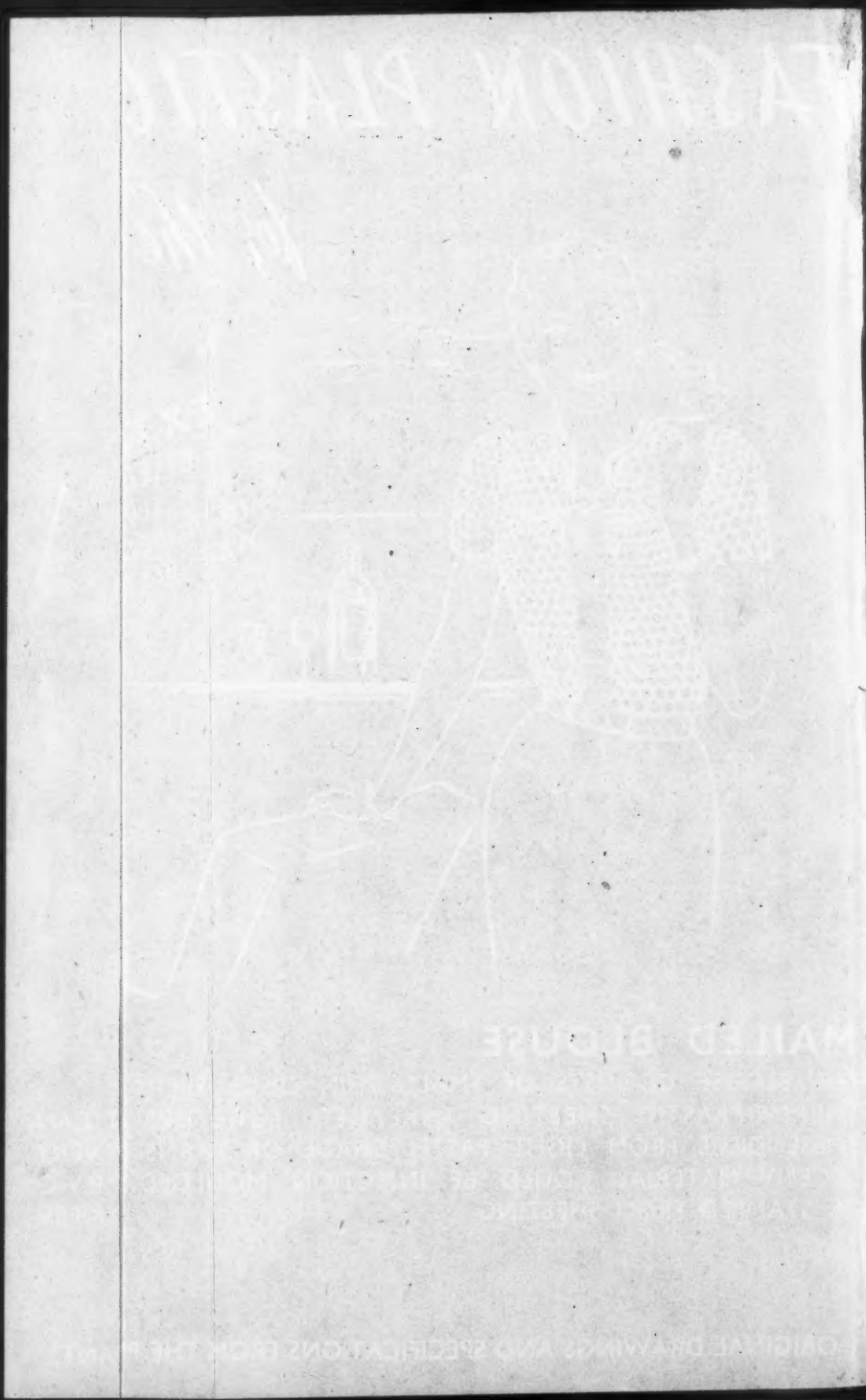
DED RIBBONS OF A TRANSLUCENT P.V.C.
MEDIATE LAYER OF COLOURED STRIPES.

GEORGE P. E. SCHUELER, CONSULTANT



World's Industry Employs Plastics

GENERAL ENGINEERING

Valve seats made of plastics will hold air pressures of over 2,500 lb./sq. in. if used in conjunction with surfaces which have not been hand-lapped. (Scientific American, 1946/175/8.) **Resin-impregnated bearings** made of wood seem to be the answer to many lubricating troubles experienced in light machinery, especially sensitive machines. A test with perambulator bearings of wood into which fine emery dust had been thrown showed that the wear of the bearing was 0.0005 in., and that of the steel shaft 0.003 in., corresponding to a normal life of two years. (Modern Machine Shop, 1946/July/158.) **Removal of inserts** from plastic moulds is made easier by use of two high-power tools developed by Keller Tool Co.; one has a torque of 8 ft./lb. and 300 r.p.m., the other, 2 ft./lb. and 900 r.p.m. Both tools can be operated in either direction. (Modern Machine Shop, 1946/July/252.) **Plastic locking rings** replaced the normal locking rings in a simple system for interlocking various parts developed by the German Wehrmacht. An example, the fixing of a bush in its fork, is demonstrated. The plastic is injected through a sprue while warm; for dismantling, the plastic is sheared, using special press. (Machinist, 1946/90/632.) **Design tolerances** for transparent acrylic plastics have been worked out by engineering staffs of Roehm and Haas Co., and Lockheed Aircraft Corporation. Machining, forming, assembly and installation are covered. (Product Engineering, 1946/July/110.) **Fibre glass reinforced plastics** are discussed from the engineering properties aspect in a paper presented by G. Slater to the Society of Plastic Engineers; many new facts about these products are disclosed. (Product Engineering, 1946/17/117.) **Engine research** is aided by use of transparent plastic models of machine bearings. According to the Westinghouse Electric Corporation, this work may ultimately result in the production of more powerful motors for American factories. Lucite, machined to close tolerances like metal, is made into models of bearings and journals. Such bearings enable the research worker to look inside the moving assembly to see what is happening to the lubricating oil.

ELECTRICAL

Usefulness of plastics in electrical applications is due to the fact that few materials are equal in both mechanical strength and dielectric properties. Materials of good electrical insulating properties, such as glass, paper, wood, ceramics and textiles, cannot be moulded into intricate shapes so easily as plastics. (J. Delmonte, in "Machine Design," 1946/18/114.) **Mica and soft glass** are combined for the production of the American G. E. Mycalex, and favourable characteristics of this material for electrical applications are discussed in "Materials and Methods," 1946/July/87. **High-frequency cables** offer a good example of a development calling for several plastic materials combining electrical properties of a high order with specific mechanical characteristics. The theoretical requirements of plastics and their behaviour under elec-

trical stress are discussed by P. R. S. Gibson ("Electrician," 1946/Aug. 16/443). The principal electrical properties are conductivity, dielectric strength, permittivity and power factor.

MOTORS

Motorcars with tubular chassis and plastic body are being made by The Bobbi-Motor Corporation in Los Angeles. It is intended to produce 75,000 of these cars equipped with air-cooled two-cylinder engine at a price between $490 and $590. ("Polyt Tijdschrift," 1946/**1**/13A.) This plastic-bodied car is described as a 2,400 lb. five-passenger convertible model. Front fenders and hood are in one piece and the entire body is fashioned of plastics.

MISCELLANEOUS

Thermosetting adhesives are reviewed in working and cure characteristics by P. C. Fuller and R. L. Hiller. Selection of a proper adhesive for both plywood manufacture and assembly glueing is guided by physical properties and chemical resistance. (Product Engineering, 1946/July/84.) **Technique in working plastics** is the subject of a 20-page supplement to a recent issue of American Machinist, 1946/**90**/651. The latest information from many sources is condensed, excellent drawings with details on mould practice being given; the use of diamond tools, however, has been completely overlooked. **Synthetic resins** are to be manufactured at a new plant in Spain; a yearly output of about 2,000 metric tons is said to be sufficient for domestic needs. (Foreign Commerce Weekly, 1946/June 22/59.) **Secondary structures for aircraft** as an application of plastics are reviewed by B. Jackson. (Pract. Engineering, 1946/**14**/39.) **Influence of moulding conditions** on the tensile properties of ethyl-cellulose has been carefully investigated by W. E. Gloor, W. C. Goggin and H. K. Hariland; interesting results recorded have been used in setting new specifications. (A.S.T.M. Bulletin, 1946/May/45.) **Impact Strength** may be examined quantitatively on small specimens (1 by 0.1 by 0.2 in.), using a laboratory method developed by A. Bailey and O. W. Ward. The flight of a steel ball down an inclined tube to hit the test specimen is used as a measure of impact strength. (A.S.T.M. Bulletin, 1946/May/50.) **Plastic belt,** 0.005 in. thick, 3½ ins. wide, and 12 ins. in periphery, and a saphire stylus for "embossing" the sound, is used in a New American recorder. (Machine Design, 1946/**18**/99.) **Heavy-duty plastics production time** is to be greatly reduced as a result of a new semi-automatic preforming press which permits high-bulk phenolic materials, previously preformed by hand, to be formed into units weighing as much as 1 lb. (Scientific American, 1946 / **175** / 36.) **Coin machines,** pin-ball machines, and vending machines are now being made of plastics. The materials employed endure rough treatment, yet still retain their clean and colourful sales appeal. Balls and bells of expanding cellular plastics are now being marketed for Christmas decorations. (Scientific American, 1946/**175**/24.) **Nail holes in rubber tyres** can be sealed by a new rivet, consisting of a circular rubber base and a rubber stem with helical steel needle. The stem is lubricated with rubber cement, and the needle is pushed through the hole from the inside. (Construction methods abstr. in McGraw Hill Digest, 1946/July/25.) **Bonding of phenolic laminates** with furane-resin adhesives has been investigated. Even with smooth surfaces, these bonds did not deteriorate on ageing, although a temperature of 200 degrees F. was maintained for a year. ("Plastics," Chicago,

1946/April/62.) **Plastic helmet** for football players has been introduced by a Cincinnati firm. It is said to give greater protection and weigh half as much as the leather-and-fibre type. **New plastics films** are considered from the viewpoint of their packaging qualities in "Modern Packaging" (1946/May/141). General characteristics of regenerated cellulose, cellulose acetate, ethyl cellulose, cellulose nitrate, polyvinylidene chloride, polyvinyl chloride-acetate, polythene, nylon, polyvinyl alcohol and polystyrene film are evaluated. **Electronic heat-sealer,** developed by Singer Sewing Machine Co., will handle thermoplastic materials in thicknesses from 0.002 to 0.05 in., forming a narrow, continuous weld at a speed, in the thinner gauges, as high as 35 ft. per minute. This speed is 3½ times as fast as that of the earlier types of electronic sealers. Current is obtained by plugging into 110-volt A.C. circuit. Means are provided for slower rates of feed, with power to handle thicker material. ("Modern Packaging," 1946/May/120.) **Air-drying thermoplastic,** Bunatol 785, is used for plating racks; only a few coats are necessary to form a thick and tough insulation which stands up to the cleaner in copper-nickel-chrome cycle. ("Products Finishing," 1946/July/98.) **Thermosetting silicone resin,** DC 804, is being employed to produce heat and moisture-resisting paints of exceptional quality with mar-resistant surfaces. The resin forms a group with similar resins previously announced as DC 801, 802 and 803. ("Products Finishing," 1946 / July / 98.) **Durable covering for interior walls** is created by fabric impregnated with synthetic resins. The product is described as "a two-ply laminate of paper and fabric impregnated with polyester thermosetting resin." ("Plastics," Chicago, 1946/August/40.) The product is easily worked into and around corners, although its thickness is twice that of average wallpaper. Ageing tests show no tendency to crack or peel. **Tooling of Cataform,** a filled acid-accelerated resin of the thermosetting phenolic type, is described in "Practical Engineering," 1946/**14**/152. The various types of moulds of plaster, metal and wood are discussed, as well as the mixing, pouring and curing. **Synthetic-resin adhesives** for wood (Brit. Standards 1203 and 1204) are based on research work carried out over some years by the Forest Products Research Laboratory ("Standards Review," 1946/July/5.) **Bakelite coffins** are to be made by a new Dutch company formed with a capital of one million guilders. By reason of the saving in imported timber which will result, the company will receive Government support. The Bakelite will be specially processed to increase its durability. **Dutch plastics industry** and its rapid post-war development is reviewed in a Dutch economic paper. ("Econ. Voorlichting," 1946, August 8.) **Australian plastics industry,** in which 600 hydraulic presses are now operating in 104 plants, and which employs 2,300 persons producing goods to the annual value of £1,266,000, is the subject of a survey issued by the Department of War Organization. **Artificial teeth** made of porcelain were imported into Australia from the United States prior to 1939; in 1945 teeth made of acrylic resins were produced at the value of about £14,000 per year.

SOURCES OF REFERENCE.

We wish to remind readers that the sources of reference from which these pages are compiled are not, in general, retained in this office. We cannot, therefore, undertake to supply such originals. Nevertheless, most of the foreign journals referred to are available in the Patent Office Library (Southampton Buildings, Chancery Lane, W.C.2) and in the Science Library (South Kensington). Photo-duplicated copies of articles may be obtained from the Photostat Dept. of the Patent Office.

Deposition of Metal on Plastics

By E. A. Ollard, F.R.I.C., F.I.M., and E. B. Smith

OVER the past ten years enormous strides have been made in the production of plastic articles and a large number of new plastics have been evolved. A variety of articles and components which used to be made of metal are now pressed out from plastic material; it is, perhaps, not unnatural that the attention of many people has been drawn to the possibility of imparting a metal finish to these articles so that they may resemble their metallic forerunners.

Apart from the question of mere appearance, the possibility of producing a metallic coating on a plastic article is of interest from the point of view of its mechanical and electrical performance. Such a coating may considerably increase the strength of the article and its resistance to shock, and also, in certain cases, its wearing properties, while, from the electrical aspect, the possibility of producing a thin conducting coating on an insulating base is always of great interest and has important applications for certain electrical instruments. Apart, therefore, from its appearance, the plating of certain plastic components may be of paramount importance and may enable this material to be used for purposes which hitherto had not been considered possible.

Various plastics are used for the production of plastic pressings, and not only does the substance itself vary, but in most cases fillers may be used and the filler may vary very considerably in nature from batch to batch without the knowledge of the individual responsible for the plating process. This matter complicates very considerably the operations involved because there is no guarantee that a particular plastic, although produced essentially from the same basic substance, will behave in the same manner during the electro-plating process. Thus a Bakelite plastic made essentially from a phenol-formaldehyde base may contain as a filler either wood dust or some inorganic materials, such as fluorspar. These two samples can no doubt be put out under the same name, but would exhibit very different properties when dealt with in the plating shop. Such variations must be seriously taken into account when dealing with plastic pressings, because, up to the present time, these pressings have been produced with a view only to their appearance and mechanical properties, and, therefore, the makers of the plastic material could quite justifiably vary their fillers to some extent without reference to the producers of the pressing. Thus a plater may have submitted to him two articles identical in appearance and apparently made of the same material, but containing different fillers.

There is little doubt that if the plating of plastics is to be carried out on a large industrial scale, it will be necessary for the makers of the material to specialize on suitable material which lends itself to the subsequent process involved, and also not to vary this without reference to those who are responsible for the finishing operation. However, even under existing conditions, it is quite possible to obtain satisfactory deposits on nearly all types of plastic, although some lend themselves to the operation far better than others.

Types of Plastics

Plastics have been divided into two main types—the thermosetting type and the thermoplastic type. The latter, of course, cannot be put through any process involving heat, as they soften and distort.

The phenol-formaldehyde plastics are probably the most satisfactory for plating because they are comparatively non-

porous and take a silver film satisfactorily. The majority of other plastics can also be plated but some of them are difficult to deal with unless they are coated over with a layer of some non-absorbent lacquer. Any article which tends to absorb water during the plating process will prove difficult to deal with because it is almost certain to distort and may, in certain cases, actually swell and crack the metallic layer formed on its surface. This may also happen with Bakelite-type plastics containing a large percentage of absorbent filler, such as wood dust.

Adhesion of the Coating

For the majority of purposes it is desirable that the metallic coating should adhere reasonably well to the plastic base. It is, of course, not possible to get the degree of adhesion which can be obtained on a metal surface. In fact, it is probable that true adhesion between a metal and plastic cannot actually be obtained. When a metal layer is deposited on a satisfactorily prepared metal surface, the adhesion obtained is of the same order as that of two parts of the solid metal. That is to say, the actual atoms of the metal cohere together in a similar manner and have similar force to that prevailing in the body of the metal itself. It is not reasonable to suppose that such adhesion can be obtained between two quite dissimilar substances such as a metal layer on a plastic base, but, at the same time, it is possible, by taking suitable precautions, to produce a metallic layer on a plastic surface which will adhere quite satisfactorily for all practical purposes. In many cases, also, the metal layer on the surface is in the form of a continuous envelope, and then, even if the adhesion is not as high as desirable, the metal coating will remain in place.

There is some difference of opinion as to the advisability of roughening the surface of the plastic before applying the metal coating. At first sight, it might be considered that such a roughening would give a key to the metal layer and increase its adhesion to the plastic base. It is somewhat doubtful however, whether this actually occurs, and quite a high order of adhesion can be obtained on a polished surface provided this polished surface is absolutely clean and correctly prepared. It is probable that, in many cases, the improvement which has been obtained by certain investigators through roughening the surface was due really to the fact that the process used for roughening also removed any stray dirt and grease, and that it was not the rough surface which gave increased adhesion observed, but the fact that the surface itself was absolutely clean and free from any loose material or layer of plastic which might have formed in contact with the material.

The Plating Process

Just as a metal has to be correctly prepared for plating before a satisfactory deposit can be made upon it, so has a plastic article. In the case of the plastic, however, there is another operation involved, because, while a metal conducts electricity as plastic does not, therefore it is necessary first to form on the surface of the plastic article a conducting layer on which the deposit can be made. This operation can be carried out in a number of ways, among which are the spraying of the article with metallic lacquer, coating it with graphite, reducing a silver film on its surface, spluttering it with gold or silver in a vacuum, vaporizing the layer of metal by vacuum vaporization, or spraying it with a metallizing pistol.

The general cycle of operations when dealing with a plastic will be, first, thoroughly to clean the surface; second, to render it waterproof if it is not already so; third, to produce a conducting layer; and, lastly, to deposit on this conducting layer a suitable layer of metal. These operations must be carried out with great care and under conditions suitable for the type of plastic involved, and also for the article which has been produced from it, and the choice of the correct method is of the greatest importance. This choice is best made as a result of actual experiment on the type of article concerned,

although, in some cases, the operator's previous experience may be of considerable value to him in this matter. We will now deal with each of these operations in detail.

The first essential in dealing with a plastic article which has to be electroplated is that the surface should be thoroughly clean and entirely free from grease. In many moulding operations, a small amount of grease or other substance is used to facilitate the removal of the article from the mould, and it is essential that such substances should be completely removed before the plating operation is started. Some care has to be taken in choosing a suitable method for cleaning the surface because many substances which dissolve grease will also dissolve the plastic. Thus it is not possible to place a methacrylate plastic into trichlorethylene, because the plastic will be attacked. Such a plastic, however, could probably be cleaned satisfactorily with white spirit.

Cleaning the Surface

In cleaning the metal object prior to plating, it is usual to immerse it in a tank of boiling caustic or other suitable material, but such processes are not applicable to the cleaning of plastics, and for the most part, therefore, a plastic must be cleaned in some suitable solvent which will remove the grease without attacking the material, and this solvent can be chosen only when the type of plastic and its properties are known.

Alternatively it is quite possible to produce a clean surface on the plastic by means of mechanical treatment, such as brushing with a mixture of pumice and Vienna lime, or by rumbling in a rotating barrel with a slurry of these materials. While this method roughens the surface of the plastic somewhat in many cases, it is not objectionable, and, in fact, as mentioned previously, may actually increase the adhesion of the metal layer, although this is somewhat doubtful. Such a process also has the advantage that it is applicable to practically any type of plastic, and removes not only any layer of grease which may be present, but also the slight outer layer of plastic which may, due to the condition of the formation, have a somewhat different structure from the bulk of the article. The process also has the advantage that it leaves the article wet, whereas if the plastic is degreased in an organic solvent, it may be necessary to get the surface wet before the subsequent treatment may be proceeded with. When the articles have been degreased, therefore, in an organic solvent, it is necessary to dip them through a solution containing some wetting agent, together with a small proportion of alkali which will thoroughly wet the surface, and it may also be necessary to give them some type of scouring treatment. If this has to be done by hand labour, it necessarily increases the cost of the process, whereas the barrelling operation described above will leave the surface in a satisfactory state for subsequent treatment, providing, of course, that the next operation is one in which a wet surface is necessary. If, however, the article has to be coated with a non-porous lacquer, or has to be treated by a dry metallizing process, then the degreasing in the organic solvent will prove preferable because it will not be desirable to wet the surface until after the conducting layer has been formed. The preliminary cleaning process must be chosen with regard to the subsequent process to be used.

Waterproofing

If the plastic material is of a porous nature, due either to the basic substance itself or to the filler, it will be necessary to coat it with a layer of non-absorbent material, and this can usually be accomplished by spraying or dipping it into a suitable lacquer. Care must be taken, however, not to get this layer too thick or to produce tears or other irregularities on the surface, otherwise the final layer will be unsatisfactory. It is advisable also to make certain that the article is given sufficient time to dry and the lacquer film to harden before subsequent processes are undertaken. Suitable suspension racks, etc., must also be planned, so that the articles do not stick together while drying off.

Producing a Conducting Surface

As mentioned above, a number of metals are available for this purpose, and the choice of the most satisfactory metal can only be made after considerable attention is paid to both technical, and economical conditions. In certain special cases the cost of the operation is comparatively unimportant, and it would be preferable to employ an expensive process for obtaining this layer, so as to obtain the desired results. Thus on certain electrical components where specific properties are required, the most satisfactory method of obtaining a conducting layer may be by some type of vacuum spluttering or vaporization process. This process, however, involves the use of expensive plant and usually precious metals, and is too expensive to use where large areas of material have to be dealt with at comparatively low cost.

As a general classification, the methods may be divided into three grades: "A," the production of a metal film by applying some type of powder, e.g., bronze powder or graphite; "B," the production of a metal film by some process involving atomization of the metal, e.g., vacuum spluttering, vaporizing, or spraying from an oxy-hydrogen pistol; and "C," the production of a metal film by reducing on the surface a layer of metal, usually silver, from an aqueous solution.

Bronze Powder and Graphite Process

The principal substances used for this purpose are graphite and copper powder, known in the trade as bronze powder. Graphite was one of the first substances used for producing electrotypes, and has been used for a number of years for this purpose. It has the advantage that it naturally tends to adhere to any surface on which it is brushed, but although it produces a conducting layer, the conductivity of the layer is not very high. The graphite may be applied in a number of ways. If the surface is rendered somewhat tacky by the application of a suitable solvent, the graphite powder may be brushed on to it dry and then polished off with a soft brush. The operation, however, is not a very pleasant one to perform, and it is very often found preferable to use the graphite wet. Certain special preparations of graphite are now available which are dispersed in water, and these may be applied directly to the plastic surface by means of a suitable brush or by pumping through a jet and impinging a stream of liquid on the article to be treated.

In some cases the graphite may adhere sufficiently well by itself, but it may be found desirable to incorporate with the graphite mixture some type of binder, e.g., albumen or size, which will assist in retaining a considerable layer of graphite on the surface to be treated.

Choice of Graphite

As mentioned above, graphite itself does not conduct very well, and the layers formed by this material take some time to cover over in an electro-deposition bath. Efforts have been made from time to time to increase the conductance of graphite, and somewhat improved results have been obtained by adding silver nitrate to the aqueous suspension and then treating the article with sulphuretted hydrogen. This forms silver sulphide on the graphite layer, and definitely improves the conductance, but again the operation is not very pleasant to carry out, and it is doubtful whether it would be satisfactory on large-scale operations.

In choosing a satisfactory grade of graphite for the above purposes, it should be remembered that the particles of graphite should not be too small. Better results are obtained with a fairly large particle, which is in the form of a soft flake. Graphite of this type produces a more satisfactory conducting layer than that of the very fine dispersed "sols" which are used for certain lubricating purposes.

Use of Copper Powder

Instead of using graphite for the above purposes, finely divided copper may be used. Several metals are available in the form of fine powders, e.g., copper, tin, aluminium, brass, bronze, etc., and these

Fig. 1.—Equipment for spluttering gold and other metals. (W. Edwards and Co., London, Ltd.).

are considerably used in the trade for the production of metallic lacquers and paints. For the purpose in hand, however, it is desirable to use a powder of pure copper, and it is also desirable that this powder should be essentially free from grease. All grades of powder used, therefore, in the manufacture of lacquers are not in themselves suitable, and the manufacturers should be approached and the use for which the powder is required specified. The powder itself may be further degreased if desired by contracting with a suitable organic solvent, e.g., ether.

These copper powders are usually employed in some type of lacquer base, and such a process also has the advantage that the lacquer film itself renders the underlying surface waterpoof. It must be remembered, however, that the lacquer does not conduct electricity, and, therefore, if the metal powder is mixed with a lacquer in the ordinary way and sprayed on to the surface, a satisfactory conducting layer will not be formed. The usual procedure is first to spray the surface with a mixture of lacquer and metal powder, using a lacquer containing a much higher proportion of thinner than usual, and then, while the surface is still tacky, to brush over it with a metal powder. This forms a metal layer on the surface, which conducts reasonably well, and if the operation is carefully carried out, the article can be struck over in a copper bath with very little trouble. The operation, however, involves a certain amount of handling, as the article has to be carefully brushed over after spraying, and this renders it somewhat objectionable if it has to be applied to small articles of difficult shape.

Enhancing Conductance of Current

It is possible also to enhance the conductance of this metallic layer by subsequent treatment. If an article so treated is dipped into a silver cyanide solution it will take a silver coating, and this silver coating may be still further thickened by reducing on it another coating of silver by means of a solution of silver nitrate and a solution of pyrogallic acid, both of which are mixed together immediately prior to the silver operation. It is, however, doubtful whether such treatment is worth while, because the process involves the use of a number of expensive operations and has little or no advantage over the production of a direct silver film. For most purposes, therefore, it will be sufficient to coat the article with a copper powder, as suggested above, and then to place it directly into the depositing bath.

Atomization Process

It is possible to produce a metallic film on the surface of a plastic or similar material by atomizing the metal and either spluttering or spraying it on to the surface. This can be done in several ways:—

1. **Vacuum spluttering.** This is essentially the process used by Edison in making the original phonograph records. It consists in placing the articles in the chamber in which a high vacuum can be produced and putting opposite to them two electrodes of gold or other suitable

metal. The chamber is then evacuated and a high voltage electrical discharge passed between the two electrodes. This splutters over a certain amount of the metal which is carried across the vacuum and deposits on any article with which it comes in contact. The layer so produced is continuous and has a fairly high conductance, and, if the operation is correctly carried out, forms one of the most satisfactory methods of producing a conducting layer. The apparatus, however, is expensive and the process is not easy to carry out.

To carry out this operation it is necessary to have a chamber of sufficient size to accommodate the articles concerned. The electrodes themselves are usually made of copper tube through which water can be circulated to keep them cool, and are coated with gold strip by binding this round them and fixing with platinum wire. It is essential for the satisfactory performance of the operation that water vapour should be entirely excluded and for this purpose it is usual to employ a tray of phosphorous pentoxide in the bottom of the chamber in order to absorb any water vapour present. It is also essential that no vapours are produced by the articles being treated, otherwise it will be impossible to obtain the degree of vacuum necessary. However, it has been found that certain substances which absorb moisture and vapour cannot be treated satisfactorily by the vacuum spluttering process.

The electrodes are usually arranged down the middle of the chamber and the articles to be coated placed on either side. The chamber is then sealed and evacuated until a reading of about 11 on a McLeod gauge is obtained. The electrical potential is applied by means of a transformer worked off the ordinary A.C. mains and a high voltage of about 15,000 volts employed. A treatment time of about 20 minutes is usually necessary, after which the articles, on being removed, will be found to be coated with a continuous adhesive layer of gold. It is, of course, necessary to suspend them in some suitable manner so that the gold layer may be formed over the whole surface.

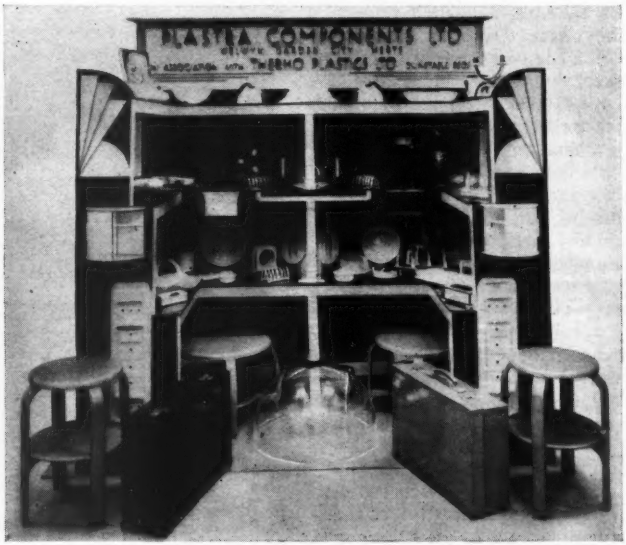
Fig. 2.—Metal vaporization equipment for coating plastics. (W. Edwards and Co., London, Ltd.).

Silver may be used as a substitute for gold, but it has not been found very satisfactory because unless great care is taken the silver oxidizes somewhat and a satisfactory layer is not produced.

While this method is very satisfactory for certain purposes, as mentioned above, it is, as will be seen from the description, somewhat expensive and difficult to carry out. It may only be considered, therefore, on articles the price of which is not of paramount importance.

2. **Vaporization in vacuo.** Instead of spluttering the metal in vacuo, certain metals can be vaporized and allowed to settle on the article in the form of a cloud. The apparatus required is somewhat similar to that previously described, but instead of the two electrodes used for the spluttering process, a small refractory boat containing the metal to be vaporized is placed in a heating coil of Tungsten wire. The whole apparatus is

(Continued on page 506)



Display of household goods in "Perspex" and laminated Bakelite by Plastra Components Ltd.

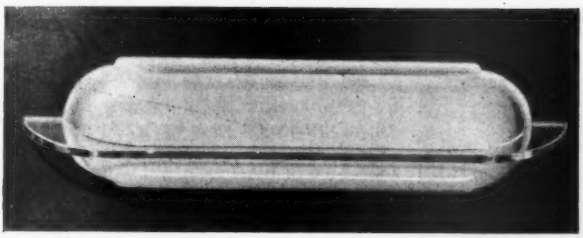
PLASTICS at WELWYN GARDEN CITY

WHEN the first idea was conceived of building garden cities it was an intentional part of each scheme to include a due proportion of industries conveniently isolated in positions on the outskirts of the residential area in a manner which would not detract from residential amenities. It was therefore with no mean anticipation of what we might find to interest us that we paid a visit to the "Welwyn Garden City Can Make It" Exhibition at the Welwyn Stores last month. In all, the products of nearly thirty of Welwyn's industries were being shown, and the attendance of visitors from August 6 to 31, as well as orders taken for home and export trade, were said to have fully justified the efforts of the participating exhibitors.

The exhibition was staged at an opportune time, almost immediately preceding the Britain Can Make It Exhibition which will open at the Victoria and Albert Museum in London on September 24. It was extended an official welcome by J. W. Belcher, Esq., M.P., Parliamentary Secretary to the Board of Trade, at the opening ceremony.

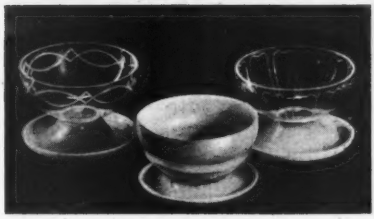
The stand occupied by Plastra Components, Ltd., Welwyn Garden City, in association with Thermo-Plastics, Ltd., of Dunstable, was constructed throughout of plastic for the displaying of a variety of household goods also made in plastics. The general colour-scheme was black and white and pale powder-blue, with a fascia of light green colour showing the name of the firm in letters of a darker green cut from thick plates of "Perspex" and mounted edgewise.

The bulk of the exhibits at this stand were made of "Perspex," clear and coloured, the colouring being pastel shades. Among articles of domestic utility we noticed toast racks, cigarette caskets, cheese dishes, powder bowls, ink-



(Left) Wall light fitting of coloured "Perspex."

(Below) Grapefruit "glasses."



well stands (cream and black), clock cases (clear and light green), stands for table lamps and accessories for the bathroom. The latter included a novel form of bathroom cabinet, of small size, with semi-circular bow-shaped front provided with a sliding door and fitted internally to hold tumbler, tooth-brushes, etc.; towel-rail in opal "Perspex" and soap and sponge holders of proportions adequate to span the bath from side to side.

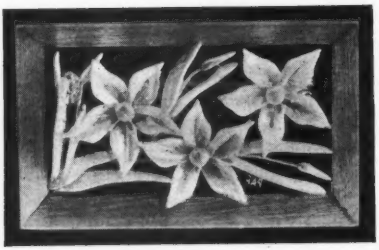
One of the novelties shown on this stand, was the wall light fitting which we illustrate, calls for comment. It comprises a reflector and cover made from coloured "Perspex." The design is simple and attractive, and the streamline obviates the collection of dust. The method of fixing is not visible, but the cover is easily detached, so that the lamp is accessible for replacement or cleaning. The luminosity of the material is such that a 60-watt element will give ample illumination; the lighting is further increased through the medium of a clear centre piece.

Plastra Components, Ltd., are also engaged in making articles from laminated Bakelite material. Among those exhibited on this occasion were suitcases, small circular coffee tables, trays for cafeterias (commended on account of their light weight and good serviceability), and removable seats and backs for chair frames of tubular metal construction.

The small circular tables and suitcases are made from a special grade of laminated phenol-formaldehyde impregnated sheet. This material offers considerable economic advantages as it can be moulded under low pressure, using inexpensive moulds, and it is, therefore, possible to produce articles in comparatively small quantities. Post-forming laminated sheets are extremely strong, durable and light in weight, and this favourable strength/weight ratio has enabled the material to be used for aircraft parts, especially as it proved very suitable under tropical conditions. The material lends itself to the manufacture of large units, and even double curvatures can be obtained without difficulty. The standard gauge is $\frac{1}{16}$ in., but other thicknesses can be supplied to meet special requirements. The texture is smooth and attractive, and as the material is practically non-hydroscopic, furniture and similar items are easily kept clean.

The manufactures shown by I.C.I. (Plastics Division), Ltd., Welwyn Garden City, included a one-piece sink and double draining board in white opalescent "Perspex," with chromium fittings for water supply and waste. Among other exhibits at this stand were "Kallodentine" artificial teeth, and "Kallodoc" artificial eyes (in both cases methyl methacrylate); "Welvic" p.v.c. calendered sheets and extruded sections; injection mouldings of "Alkathene" (polythene); brushes and surgical sutures made from nylon monofilament; surgical instruments of clear "Perspex"; and buttons of surface-dyed "Perspex."

LETTERS TO THE EDITOR



French Design

Sir,—I read your notes on "French Leave" in the August issue with considerable enjoyment and interest, and thoroughly agree with your opinion of the high artistic merit of French plastics. This refers, as I think you will agree, more to the sphere of thermoplastics than to mouldings made from thermosetting resins, of which latter I have seen many poor specimens in addition to good ones.

On the whole, and knowing your methods, I presume that you are not merely boosting French manufacture, but are desirous of showing the light to British workers in this field. How necessary this is cannot be in question: witness some of the shocking examples in the London shops.

The French, on the other hand, while not necessarily born with their special artistic taste, soon acquire it and soon show a practical appreciation of what they call "arts et métiers." They have long applied this appreciation to plastics and have a thorough knowledge of them vis à vis the industries of jewellery and other artistic trades.

To give you a good example, I am enclosing a brooch (in methyl methacrylate, I should say), upon which British workers may ponder. I picked it up in Portugal last month for the equivalent of 15s., and, as you will see, it has the word "Paris" cut on the reverse. The whole design is worked from the back, and while this type of manipulation is not unknown in England, there is something special about it. The plastic is not only deeply cut, but the work has obviously been done by a jeweller, or at least with the fine tools usually associated with the industry of precious metal working, marcassite, etc. Thus the bud seen in the right-hand corner between two leaves is not made by merely grinding the surface of the plastic, but by the use of a very fine drill cutting below the surface and at an angle.

H. COURTNEY BRYSON,
Bryson Processes, Ltd.
Irthlingborough,
Northants.

"Plastic" or "Plastics"

Sir,—I have read with great interest the letter of Mr. Clark Ramsay and your own editorial remarks concerning the use of these words, particularly as I recently gave thought to this very matter and consulted different authorities to help me in making a decision. I do not like either word, and consider them inadequate to describe *our* great and growing modern industry. Those who were in at the beginning of this industry, some 20 to 30 years ago, will remember the efforts made to find a suitable name, but without success. Our friends in America largely use the name "resinoid." In this country, however, the words "plastic" and "plastics" have come to be used.

I agree entirely with Mr. Clark Ramsay that, of the two, the word "plastics" is correct. I do not know how long the word "plastic" has been in existence. Certainly in my experience it has always been classed as an adjective, used for describing an intermediate stage through which a large quantity of materials pass before reaching their finished or final stage. In their "plastic" stage these materials are, for practical purposes, largely useless. Glaziers' putty comes to mind as an illustration; if it retained its applied "plastic" state it would not be very acceptable for fixing windows.

With regard to thermoplastics, these pass through this same intermediate

" plastic " stage and then become either rigid or merely pliable in their finished stage, and it is only by reprocessing that they can be again made " plastic."

Whatever word is used for describing *our* industry will apply to the finished products, and if a word already in use and having a known and accepted meaning is chosen, then the meaning of such a word must accurately describe the finished product. Therefore, the word " plastic " fails to be acceptable. The word " plastics " is not much better, but, at least, it does not infer to the same extent some kind of putty-like material, entirely different to what modern plastics are.

You ask if it is too late to find a suitable name. Certainly not. If the British Plastics Federation asked all their members to use any particular word it would be quickly popularized and pass into general use. It is a matter for the British Plastics Federation to deal with, and I for one would like to see it dealt with.

BIRKBYS, LTD.
Liversedge, Yorks. A. T. BIRKBY, Managing Director.

Glazing for Greenhouses

Sir,—Being interested in plastics and also in the growing of plants, I naturally think of plastic greenhouses. The advantages of a plastic greenhouse would be the reduction on maintenance costs both in painting and in replacement of glass panes, and I think that the drip would be reduced. However, at the moment, the price seems to rule it out. A friend of mine has calculated that to glaze a new greenhouse he is building, using Perspex instead of glass, would cost £234, against £47.

If any readers of " Plastics " have ideas for the construction of greenhouses entirely from plastic, or from plastic fixed together with extruded light metal strip with the chief aim of reducing maintenance costs, I shall be pleased to hear from them.

A. J. S. MCMILLAN, F/LIEUT.
Officers Mess, R.A.F. Station,
Benson, Oxon.

Tubular Plastic

Sir,—We shall be glad to have names of manufacturers of tubular plastic.

KENMAC MANUFACTURING CO., LTD.
117, High Street,
Brentford, Middlesex.

[EDITOR'S NOTE.—Thermosetting extruded tubular material is made by Cellomold, Ltd., Feltham, Middlesex. Suppliers of thermoplastic tubes include:—BX Plastics, Ltd., Larkswood Works, London, E.4; Exceloid Co., Ltd., Lichfield, Staffs; Duratube and Wire, Ltd., Feltham, Middlesex; Souflex, Ltd., Maida Vale, London, W.9. The Textile Paper Tube Co. Ltd., of Romiley, near Stockport, manufacture a stiff paper tube lightly impregnated with phenolic resin.]

P.V.C. Sheeting

Sir,—We are desirous of contacting manufacturers of transparent plastic material of fine weight, similar to that used in the manufacture of rain-wear.

BURNS, PHILP AND CO., LTD.
35, Crutched Friars,
London, E.C.3.

[EDITOR'S NOTE.—Makers of P.V.C. sheeting, among others, are:—BX Plastics, Ltd., Larkswood Works, London, E.4; I.C.I., Ltd., Plastics Division, Welwyn Garden City, Herts; Pirelli General Cable Works, Ltd., Eastleigh, Hants; Vinyl Products, Ltd., Carshalton, Surrey; P. B. Cow and Co., Ltd., Streatham Common, London, S.W.16.]

Clothes Pegs

Sir,—We will be obliged if you would put us in touch with the makers of " everlasting " clothes pegs made in plastic.

P. AND R. FLEMING AND CO.
29, Argyle Street,
Glasgow.

[EDITOR'S NOTE.—We believe this type of peg is made by E. K. Cole, Ltd., Southend-on-Sea, Essex.]

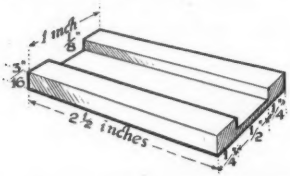
Salad Servers

Sir,—We shall be obliged for names of the makers of the plastic salad servers we have seen on the market, as we are desirous of shipping these to Australia.

P. FALK AND CO., LTD.
38-39, Broad Street Avenue,
London, E.C.2.

Tooth Plaques

Sir,—I require tooth plaques of the shape shown in the accompanying drawing, to be made in clear or pale pink plastic, with lettering in gold. They have



previously been made in pressed metal, stove-enamelled. I would appreciate your kind assistance.

Northolt, Middx. F. H. LEIGH.

[EDITOR'S NOTE: There would be two ways of making these tooth plaques. One method is that of straight moulding using, say, cellulose acetate powder. In this case the mouldings should be fairly cheap if the number required was high. It would be possible to add any desired lettering, in a different colour, at the same time. The second method, which might be cheaper, would be to extrude cellulose acetate or similar material in long strips, which could then be cut to size. In this case the lettering would have to be added by transfers.]

Plastic Bowls

Sir,—We are requiring small plastic bowls for wholesale supply to the florist trade, for use as bulb bowls, etc. We mainly require a bowl approximately 5 ins. in diameter, but also a larger size of about 7-in. diameter.

COCQUEREL'S SUNDRIES, LTD.
28, Wellington Street,
Covent Garden, London, W.C.2.

[EDITOR'S NOTE: A similar inquiry has been received from P. H. Tonkin, Ltd., 21, King Street, Truro.]

Writing Desk Equipment

Sir,—We notice in the August issue of "Plastics" a trade inquiry for Carvacraft. We would advise you that this covers a range of writing desk equipment which is made by this company.

JOHN DICKINSON AND CO., LTD.
Hemel Hempstead, Herts.

Plastic Bonding of Light Metals

Sir,—We have read with interest the article in the July issue of "Plastics" (page 357) on the plastic bonding of light metals. We are very interested in the applications of this technique, and should be obliged if you could let us know whether any further details may be obtained. We should like to know particularly if the Araldit resins are available in this country.

BRITISH INSULATED
CALLENDER'S CABLES, LTD.
Belvedere, Kent.

[EDITOR'S NOTE.—Letters on similar lines have been received from Arnolite, Ltd., and Dowty Equipment, Ltd.]

Novelties in Transparent Plastic

Sir,—I am the English representative of some of the largest departmental stores in Switzerland, who are very interested in British supplies of plastic novelties in Perspex and any other articles in transparent plastics.

I have noticed attractive articles made of coloured Perspex, such as cigarette boxes, bowls, salad sets, etc., and would welcome contact with manufacturers of these lines, so that I could introduce their goods to the Swiss market.

M. O. HENCHOZ.
Stanthorne, Burtans Way,
Chalfont St. Giles, Bucks.

Melamine Resins

Sir,—I shall be glad to have the name of makers of melamine-formaldehyde resins suitable for cast moulding.

Hyde, Cheshire. G. T. GARTELL.

[EDITOR'S NOTE: It is doubtful if melamine resins are yet available for casting. It is suggested that you write to British Industrial Plastics, Ltd., London, who are the only makers of melamine resin in this country.]

Soft Furnishings

Sir,—We should be glad if you could put us in touch with firms manufacturing plastic material suitable for soft furnishings. R. BURMAN AND SONS.
Liverpool, 3.

Caravan Luxury by Use of Plastics

LUXURY in the matter of living in a caravan adds materially to the enjoyment thereof. We saw our caravan while passing through part of Berkshire, and the exterior appearance, prompted by the natural setting of the situation where we found it, intrigued us sufficiently to go in search of permission to inspect the interior. Outwardly, the caravan appeared to be a luxurious production. When we stepped inside we were rewarded by the sight of a kitchen compartment in which translucent plastics of light sea-green colour had been used almost wholly for the construction of the various fitments.

In general features of construction, floor, walls, and roof had been prefabricated from aluminium alloy, incorporating a patented method. Actually, there was an outer wall of thin aluminium alloy, then an air cavity filled with "Isoflex" plastic insulation, a second or intermediate wall of light metal, and an inner wall of expanded synthetic rubber. The latter, ¾-in. thick, embodies a vast number of sealed air cells for giving a degree of heat and sound insulation which is more than equal to that of the average cavity wall employed in a house built with bricks. The interior finished surface was an oak veneer laid upon this "Onozote" synthetic rubber, and wax polished.

Apart from the spaciousness of the accommodation provided for sitting at leisure in the lounge, taking meals, or sleeping at night, we noticed particularly that the amount of natural daylight reaching the interior of the caravan far surpassed anything we had seen previously. This refinement in construction had been made possible by further ingenuity in the use of plastics.

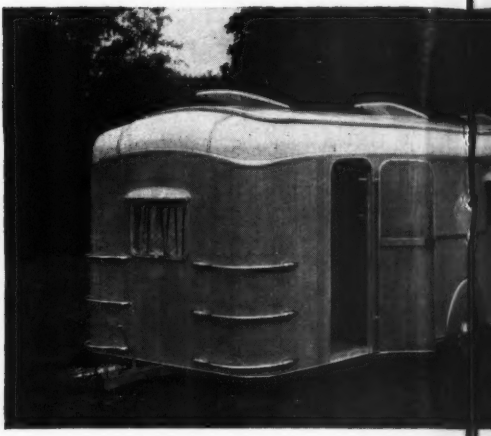
The exterior shape of the caravan was basically rectangular, but all the corners were rounded off, and where the walls joined the roof a broad belt of translucent cream-coloured "Perspex," ⅛-in. thick, suitably moulded, was introduced for the dual purpose of relieving the otherwise square-edged appearance of the body and to let the maximum amount of daylight enter at roof level. By this means of lighting the interior, secondary to the windows, there was an even flood of light reaching all corners, which was extremely pleasant to experience and gave no discomfort whatever by undue intensity when the sun was bright, likewise offering the maximum of convenience upon a day which was tolerably dull and cloudy. Upon a bright day the interior effect was that of reasonably subdued lighting, yet giving adequate knowledge of the degree of brightness outside.

We were particularly fortunate to experience the sort of lighting which would be obtained throughout winter months, for our English climate brought a temporary lull in the otherwise sunny aspect of the day, and a half-hour of rain. Due to the choice of the cream-coloured "Perspex," however, the general impression obtained within the caravan was that the sun was still shining, though somewhat less intensely.

There was also another advantage which came from employment of that broad belt of translucent plastic primarily introduced for lighting the interior of the caravan. We were told that the lighting effect at night, viewed from outside, is such that a subdued glow is emitted, and this, in turn, emphasizes the exterior of the caravan from all directions in its possibly otherwise dark surroundings; at the same time, there is sufficient light to illuminate the immediate vicinity and so enable the user to move safely.

The windows of the caravan are frameless. They are made of clear "Perspex,"

The Luxury provided by this Caravan is commendable to all who are Caravan-minded



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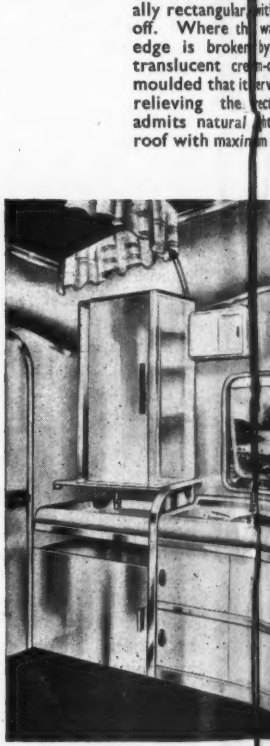
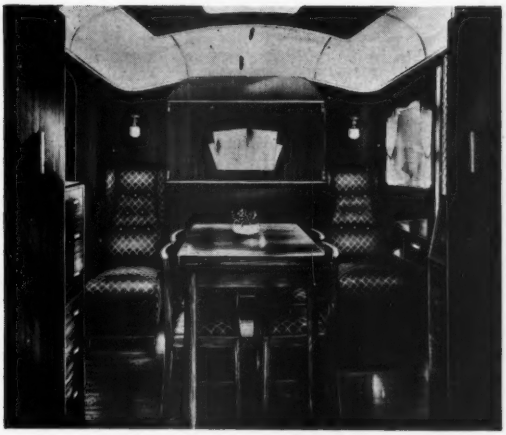
(Above) The lounge, looking towards the door leading to the kitchen. In this view of the interior, the advantage gained from the admission of daylight through the Perspex ceiling surround can be appreciated. The fitting on the right conceals a single bed. The settee on the left is a fixture, but may be used for additional sleeping accommodation.

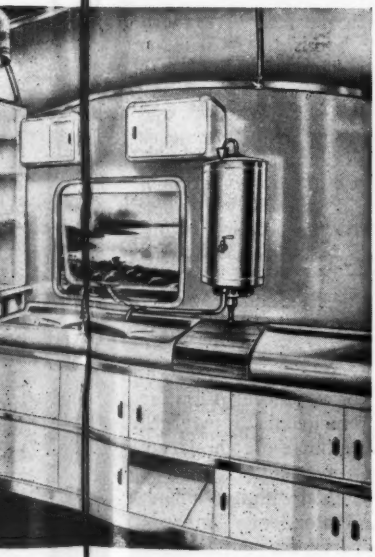


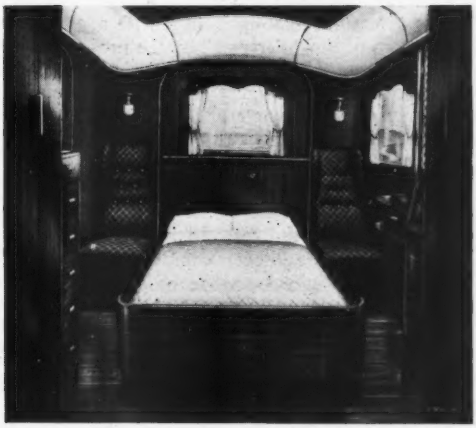
(Right) The interior fitting of the kitchen is carried out in Perspex of translucent light sea-green colour, with walls of white opal Perspex. Extruded aluminium sections are used in conjunction with the plastic to provide the necessary framework for sliding doors to cupboard accommodation below the sink. A wash-basin slides beneath the food storage cupboard on the left. The window is clear Perspex, in form of a rigid frameless moulding.

exterior sh e of the caravan is basic- rectangular ith the corners rounded Where th wall joins the roof the e is broken by the introduction of slucent cre n-coloured Perspex, so lded that it erves the dual purpose of eving the ectangular outline and its natural ht through the caravan with maxi n interior lighting effect.



All the furniture throughout the living and sleeping accommodation is in unit form, so proportioned that alternative layouts are possible to meet the wishes of the user. The fitment immediately behind the dining table opens out to provide a double bed, when the table and chairs have been moved. The mirror normally seen during daytime gives place to a window at night, for additional ventilation.





At night, double-bed sleeping accommodation is provided, over the floor space normally used at meal-time. This view is taken from the lounge. A screen, which closes concertina-fashion flush to the wall, divides the caravan into double and single bedrooms.

⅛-in. thick, moulded with the edges turned at 90 degrees. This ensures a moulding sufficiently rigid to be suitable for use as a window entirely devoid of framework.

By using "Perspex" the necessity of providing a window frame, where glazing in the ordinary sense would have been used, has been avoided; likewise, the need for glazing, thus disposing of one of the troubles of caravans in general, i.e., leakage of rainwater at the joint of glazing and window frame. Additionally, the "Perspex" is very much lighter in weight than glass, especially glass in its necessary frame. The experience of users, so far gathered, is that the "Perspex" window is also more pleasant to look through.

The same window moulding is used for the roof lights, which open for ventilation purposes. Here, translucent cream-coloured "Perspex" is substituted for clear plastic to prevent any direct passage of rays of the sun, and so be in keeping with that broad belt of cream "Perspex" which provides the main scheme for naturally lighting the interior of the caravan.

Condensation upon windows and other means of natural lighting is dealt with at the bottom of the "Perspex" by the provision of water channels. These are intended to drain away any condensation that may occur in winter, although the special radiator heating with a ventilation chimney tube, which is provided as part of interior fitting, is designed to prevent condensation occurring under any circumstances while the caravan is in use.

The walls of the kitchen compartment are lined with white opalescent "Perspex"; the fitted units are moulded in "Perspex" of light sea-green colour. Extruded aluminium sections provide the needful framework for sliding doors in front of cupboard space.

Referring to the illustration of the kitchen, the cupboard on the left-hand side is intended for food storage space. The walls of this cupboard are made of translucent "Perspex" and are so shaped that they provide a hollow space for the storage of water, which runs by gravity to the tap over the sink. Shelves of the same material are provided in the food cupboard. The storage of water in the manner indicated has a twofold advantage; it is a clean, hygienic method of storage, and water so held in reserve has a cooling effect for the food-storage accommodation, provided it is changed daily while the caravan is in use, or more frequently, if need arises, during hot weather.

Behind the sliding doors, which are seen below the sink and kitchen table-top, the shelves are in the form of removable trays made of "Perspex" of that same light sea-green colour. These trays are arranged alongside each other over the whole length of the available cupboard accommodation, and, due to the translucent nature of the plastic used throughout in the construction of the kitchen fitments, the light from the window passes through sink and table top to illuminate the interior of the cupboards beneath.

"Perspex" was selected for the internal fitting of the kitchen on account of its general cleanliness and the pleasant appearance which results. It is not affected by grease, and is easy to maintain in a clean condition by mere use of soap and water. In contact with food and water it has no deleterious action, and in general appearance it is almost as attractive as glazed tiles, the use of which would be out of the question on account of their weight. Personally, we appreciated this point on the occasion of our inspection of the caravan, having had experience of working in a kitchen of small dimensions where a suitable colour scheme did much to make things more pleasing.

The makers of this luxury caravan, which is so well provided with furniture built on the unit principle that it may well become a complete home on wheels, are Coventry Steel Caravans, Ltd., of Warwick. Our first contact with it was made through R. H. Linton, of Winnersh, Berks, caravan distributor.

NEW METHODS FOR TEXTILES

A NEW basic process for the manufacture of textiles is being developed in the United States by The Chicopee Mill Co., of Milltown, N.J., in form of a machine which takes in the cotton at one end and turns out fabric at the other end, without either spinning or weaving in the recognized sense of those operations. Hitherto, even the strongest textile has depended largely upon friction to hold the fibres together. The new process, however, substitutes the positive action of a plastic binder.

In the Chicopee machine the raw cotton is first combed out to form a continuous "web," which resembles fluffy cotton wool or wadding, about a quarter of an inch thick and 40 inches wide. It is then passed between rollers, where it is compressed to normal fabric thickness, and then over-printed with liquid plastic which exerts a binding effect upon the individual fibres to hold them permanently in position. The plastic imprint can be colourless and purely decorative, i.e., it may be in the form of cross-wise lines spaced about a quarter of an inch apart, or otherwise providing a decorative design of any desired colour. The printed material is dried by aid of heated cylinders, and is then wound upon a reel. Fibres apart from raw cotton can be handled in the same way.

This new "non-woven" fabric is likely to be produced much cheaper by comparison with textiles made in the conventional manner, not only for the reason that many complex operations are eliminated, but also because it requires much less basic fibre to cover a given area. One pound of cotton, which will make only 8 yards of spun and woven open-mesh gauze, should now be capable of producing 24 yards of "non-woven" cloth. The new product presents an almost continuous surface in contrast to the visible porosity of even the closest woven textile. Thin towelling, already in production, resembles a thin, white cotton flannel having all the resiliency of a woven fabric. When dipped in water it is instantly absorbent, without any noticeable loss of strength.

Materials produced by this new process of manufacture have already found application as towellings, milk filters and linings, but have not yet been made strong enough for shirts or sheets. It has "one-way strength" across the fibres. In the direction of the fibres it tears easily. Yet a method of cross-laying the fibres may ultimately provide two-way strength, provided the requisite machinery can be designed.

Another "non-woven" cloth, of United States origin, evolved by the Kendall Mills Co., Walpole, is claimed to be capable of being "stitched without sewing." Here, plastic is mixed in fibre form with the cotton fibre, the whole being bonded by the pressure of heated rollers. The resulting fabric can be almost as thin as tissue and as transparent. It is due to the precise nature of the plastic bonding that two thicknesses can be firmly "stitched" by the mere application of heat and pressure.

SPRAYED PLASTIC PACKAGING

A new "sprayed-on" plastic packaging material, of which particulars have been disclosed by the Publication Board of the U.S. Department of Commerce, is claimed to be adaptable to all sizes and shapes of equipment, does not adhere to metal, and is proof against penetration of moisture vapours. Strips of tape, connecting the outermost projection of the equipment, are used to provide a framework for the first coating, which consists of long, web-like threads applied with a spray gun. Three main coatings are then sprayed over the primary web-like structure, each having a different colour for identification; as they dry they contract to form a tight package. Finally, a small square is cut from the coating, and solvent vapours are blown out of the package with a hot-air blower. A drying agent is placed in the package, and the square opening is then covered with a transparent window for inspection purposes.

The Microscopic Examination of Plastic Materials

VI.—Mouldings: (b) Fillers (Coconut Shell Flour) —contd.

By J. H. WREDDEN, F.R.M.S.
(Chief Chemist, Igranic Electric Co., Ltd.)

In this instalment the author continues the examination of the coconut shell as a potential source of filling material. He has already shown that its structure is somewhat different from that of the true woods previously dealt with, inasmuch as coconut shell is very much more highly lignified than wood, although the structure is based on typical botanical tissue elements, i.e., tracheids.

THE lignification of coconut shell is so high, and the orientation of the tracheids is so different from that found in wood, that the final result may almost be looked upon as an entirely separate material. We have seen that the tracheids are much shorter and also possess very much thicker walls than any which were encountered in our study of the woods. It will be shown subsequently that some of them are so small that it is very probable that they are much the same size and shape as the original cell from which they were developed.

It was also pointed out that, owing to the particular type of thickening encountered in the coconut shell tracheid, the breakdown of the shell when subjected to grinding operations would be expected to take place in a certain direction; that this actually took place was also shown, following which it was possible to form an opinion of the behaviour of the flour when used as a filler for a phenolic moulding powder.

As a result of this examination, it may be assumed that very heavy lignification confers definite advantages on botanical material when used as a filling medium. Thus, in the case of the coconut shell, this characteristic would appear to produce better impact strengths than wood flour; on the other hand, the tensile strengths produced by the use of the shell flour are lower. However, as the resistance to impact, of a moulding, often appears to be the more important characteristic, it would seem that there is something to be gained by the use of coconut shell flour.

We have also seen that a powder containing 50 per cent. coconut shell flour has better flow characteristics than one containing the same proportion of wood, although it should be pointed out that on reducing this proportion of coconut shell flour below 35 to 40 per cent. the flow characteristics show signs of deterioration at a more rapid rate than that experienced with equivalent proportions of wood flour as a filler. It is probable that this is due mainly to the low specific volume of shell flour, which in turn would appear to be influenced by the specific gravity, which is higher than that of wood flour, although the inter-relationship between specific gravity and specific volume must be borne in mind. It is likely that the particle shape and size have a big influence on the specific volume, for it will be seen that the greater proportion of the coconut shell flour consists of portions of the tracheids, and also that these tracheids have practically no bore. When the shell flour is compared with wood flour, particle for particle, this latter will be seen to contain a much greater proportion of air, due to the comparatively large bores and thin walls encountered in the wood tracheids and vessels.

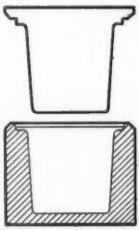


Fig. 110.

Fig. 111.

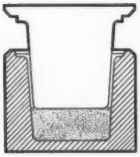


Fig. 112.

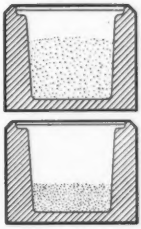


Fig. 113 and 114.

We see that, weight for weight, wood flour occupies a larger volume than coconut shell flour. This property will be seen to be advantageous for producing good flow properties, as the powders possessing wood fillers will also have a higher specific volume and would not tend to pack down into the bottom of the mould, thereby making it more difficult to fill interstices above the powder level. Regarded from this point of view, a given powder may be said to possess a "compression ratio" dependent on its specific volume.

For example, if we take a powder such as magnesium oxide, which has a low specific volume (in other words, the particles themselves are solid and dense and pack together as a powder, with little or no air spaces), and a correspondingly low "compression ratio," its behaviour, so far as packing into the bottom of a mould is concerned, tends towards the same characteristics possessed by a liquid under these conditions, without, however, possessing the advantage of the mobility of liquids.

If we imagine a simple cup mould with a flanged lip around the top, as shown in Fig. 110, it will be seen that, as the draw is fairly deep, a powder which possesses a wide "compression ratio" will tend to produce easier moulding conditions than would be the case with a powder having a small "compression ratio." The "compression ratio" should not be confused with the "bulk factor," this latter being the ratio of the apparent density of the moulding powder to that of a finished moulding made from the same material; it does not convey the same information as the "compression ratio," which may be considered as a ratio of specific volumes.

Knowing that a wood flour filled powder possesses a higher specific volume than one filled with coconut shell flour, let us proceed to examine the effects produced by these two powders in the mould.

Figs. 113 and 114 show the same mould cavity containing, in the first case, the requisite quantity of wood flour filled powder, occupying somewhat more than half the mould cavity, while the volume occupied by the equivalent weight of coconut shell flour filled powder is considerably less than half that of the mould. At the same time, it should be borne in mind that the shell-filled powder is already in a higher state of compression than the wood-filled powder, by virtue of its lower specific volume.

If we imagine the mould to commence closing and to continue doing so until a point has been reached where the upper half starts compressing the powder, as shown in Fig. 111, which shows the mould in a partially closed position for the wood filled powder, we see that the powder already experiences some slight compression and that it has also risen somewhat up the sides of the mould. Assuming, for purposes of discussion, that up to now no liquefaction of the resin has taken place, and that flowing of the liquid resin does not occur until the pressure gauge of the moulding machine commences to read "pressure," with further closing of the mould we find that further movement of the powder

will take place, tending to compress it still more and to fill the mould until a point is reached when the exit of surplus powder is cut off. Still further movement of the mould commences to produce a hydraulic pressure in the material as the resin liquefies.

The foregoing, although hypothetical, and in the absence of accurate information, may be regarded as a reasonable representation of the sequence of events; the moulding powder has been subjected to flow and compression before general liquefaction of the resin has set in. In other words, there has occurred a preliminary "flow" preparing the way for final liquid flow and compression, from which it will be appreciated that a powder behaving according to this ideal concept would improve matters considerably.

Now consider the behaviour of the coconut shell flour filled powder under similar conditions (Fig. 112). The volume of the quantity of this powder required to produce the moulding under discussion is considerably less than that for the same quantity of wood flour filled powder, and, further, owing to the more compact nature of the powder, it packs down into the mould forming a more homogeneous mass, so much so, that with the mould closed to the same position as indicated in Fig 113, the upper half of the mould is only just touching the surface of the powder, and further closing of the mould will not produce the same preliminary flow as was the case with the previous example.

There would appear to be several reasons for this, thus the movement of the mould during which preliminary flow may occur, is much less than in the former case, and owing to the low specific volume of the powder under discussion the mobility is also lower, so that, assuming that the top half of the mould touched both powders at the same time, then it is reasonable to suppose that more preliminary flow would be experienced by the wood filled powder.

This lack of mobility is mainly due to the nature of the elements of the filler; as we know, these are hard and contain little or no air space, therefore they are incapable of undergoing further compression to any great extent; furthermore, their shape is such that they tend to pack together much more uniformly. As a result of this, the powder in the mould will be subjected more to compression than preliminary flow, until such time as the resin liquefies. When this occurs liquid flow commences, and a certain amount of turbulence is induced in the mass, which has the effect of stirring up the filler particles and causing their more even distribution throughout the mass. In this way it would seem to be possible to fill all the spaces in the mould with a mixture of more or less uniform composition of resin and fillers.

It will, however, be appreciated that in order to achieve this end, attention must be paid to the proportion of resin, and, what is probably more important, the viscosity of the mixture.

If a resin is chosen which has a low viscosity, then it would appear to be possible to produce a powder with pure shell fillers, which should possess, and indeed has been shown to possess, better flow characteristics than an equivalent wood flour filled powder. This, in all probability, is largely due to the fact that equivalent mixtures of the two fillers with a given liquid usually show the one containing the shell flour to possess the lower viscosity, and as the determination of final flow properties of a powder is governed by the resultant viscosity of the mixture of filler and liquid resin (assuming that sufficient turbulence exists to keep the mixture even during the flow period), it would appear that the use of shell flour would be somewhat advantageous, assuming that the most suitable resin has been used.

Thus it would appear that to attempt to produce equivalent flow properties with any given types of fillers, the specific volume of the latter must be taken into account, and the correct resin used with each to produce the necessary final viscosity, with respect to which it

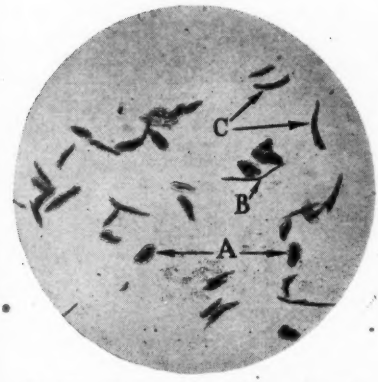


Fig. 115.—Coconut shell: tissue elements. Mag. 50 diameters.

would seem that the choice of resin would depend largely on whether more or less turbulence was required in the initial stages of liquefaction, which, in turn, is apparently dependent upon the specific volume of the filler together with the nature of the filler particles or elements; these latter, of course, depend upon the micro-structure of the parent substance.

From the foregoing, and as a result of the structure of filling materials and their parent substances, we have been led to a discussion on the behaviour of moulding powders in the mould, and the influence on this behaviour of the fillers in the powder. This has shown that the important question of flow is by no means simple, but involves a number of factors which have to be taken into account in its consideration. It seems that much more work is required on the whole question before it may be referred to in terms so prevalent at the present time.

After this brief excursion into other fields, let us continue our examination of the shell flour fillers, in particular, coconut shell.

We have already considered the general structure of the coconut shell and the manner in which it breaks down under grinding conditions. It is now proposed to examine the elements of the shell before being subjected to the destructive forces encountered in grinding. This may be accomplished quite simply by subjecting the shell to suitable mascerating treatment with any of the well-known reagents. In this way, the substance cementing the tissue elements together may be dissolved away and the elements separated in their entirety, thus enabling us to get a true picture of their shape, size and structure.

The result of mascerating and breaking down a small portion of coconut shell is seen in Fig. 115. In this photomicrograph of some tissue elements of shell thus treated, seen at a magnification of 50 diameters, the most striking characteristic is the wide variety of shapes and sizes exhibited by these structures, which are, of course, the tracheids previously described. They vary from the almost spherical shape shown by those indicated at A to the long type shown at B, the latter so long in relation to diameter that it may be looked upon as a fibre. A further shape in which the element is still long, but possesses a somewhat greater diameter than that shown at B is seen at C.

It will be appreciated that these tracheids of long, narrow shape closely approximate to the shape of a wood tracheid, although in the majority of cases they are shorter; nevertheless, in view of the conclusions reached regarding the utility of this shape of element when used as a filler, these long coconut shell tracheids show distinct possibilities. As the illustration shows that the elements in general vary from this shape to the other extreme of a spherical particle, it appears that the lower tensile strengths shown by moulding powders, using coconut shell as a filler, are in some measure explained, for, unfortunately, the long, fibrous tracheids are in the minority. We do, however, get an increased impact strength which may be explained by a surface bonding of the particles with the resin due to the lignin reacting with this latter.

Perhaps the most important point

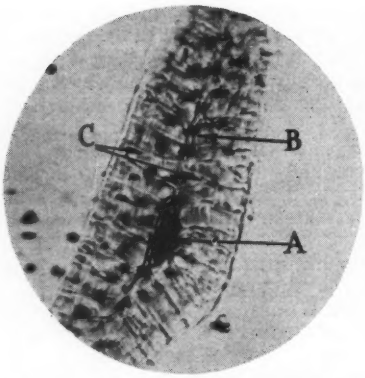


Fig. 116.—Coconut shell: characteristics of typical elemental tracheid. Mag. 650 diameters.

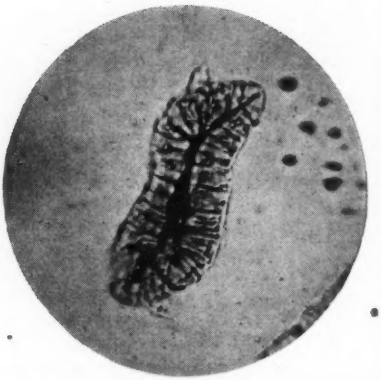


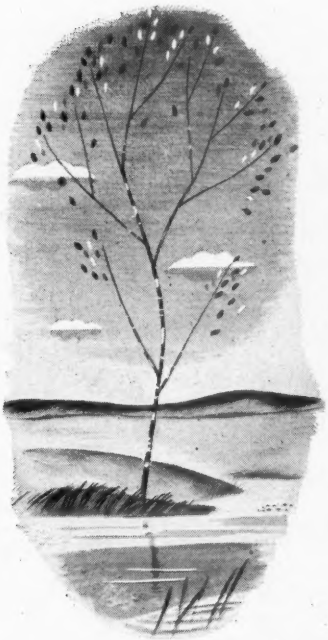
Fig. 117. — Coconut shell: elemental tracheid of smaller size. Mag. 650 diameters.

revealed by Fig. 115 is the purity of the powder, meaning the absence of extraneous matter, for the flour is seen to consist of very little else but the individual tracheids. Therefore it is again suggested that much might be achieved by examining chemical methods of preparing these powders from natural products, whereby the parent material is broken down into its constituent elements by more gentle methods than are encountered in mechanical operations. In this way will the full utilization of the physical properties of the material be made use of in the right direction, resulting in improved mouldings and moulding powders.

Having obtained a general view of the shell elements in their entirety, let us examine them at somewhat closer quarters. Fig. 116 shows one of the individual elements, photographed at a magnification of 650 diameters. This magnification is fairly high and it must be remembered that focal depth effects come into greater prominence, therefore this and subsequent micrographs illustrating these elements show them in optical section, so that we may obtain a view as general as possible in the circumstances.

The illustration under discussion (Fig. 116) shows one of the smaller tracheids, which, however, is considerably longer than its diameter. It will be seen that due to the great lignification and consequent thickening of the cell wall, the internal space has been almost completely obliterated, the only part remaining being that shown at "A." The system of channels which may be compared to the pitting of woody vessels, is clearly seen in this photograph, likewise their arrangement which would appear to take the form of radial discs of channels (as it were) arranged along the length of a long central channel which originated as the bore of the element. This latter is seen annotated at "B," while two "spokes" of a channel disc radiating from it are seen at "C." The photomicrograph shows very well the massive nature of the element, and demonstrates admirably its massive and homogeneous structure.

So much for one type of particle; let us now examine another type as typified by Fig. 117. Here again the magnification is at 650 diameters and the first point which becomes apparent is the small size of the tracheid as compared to that shown previously. The one under discussion is less than half the size of the former. In this case we see that the internal space is also larger, occupying a considerably greater percentage of the total volume



Plastics, despite the eagerness of Press and Public, have not yet come of age. It may not be realised that plastics for peace are in vastly greater demand than were plastics for war. And only by pursuing an ordered transition can we begin to satisfy this natural need. First, the machines of war production must be made over to constructive purposes. This has been done. Secondly, a complete re-martialling of manpower must be organised. This is being done. Thirdly, new plant must be installed, a larger intake of raw materials contrived and administered. As steadily as times improve, this will be done. The process may seem slow, but we believe that by active patience rather than impatient activity the Plastics Division of Imperial Chemical Industries Limited can ultimately be of amplest service.

ICI

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P.218

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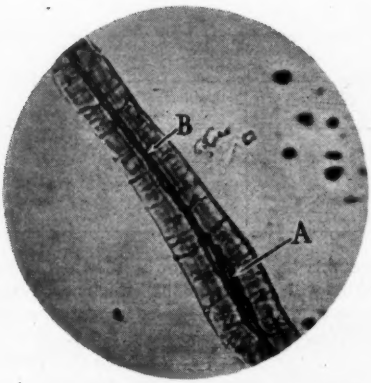

Fig. 118. — Coconut shell: elemental tracheid showing abnormal length compared with diameter. Mag. 650 diameters.

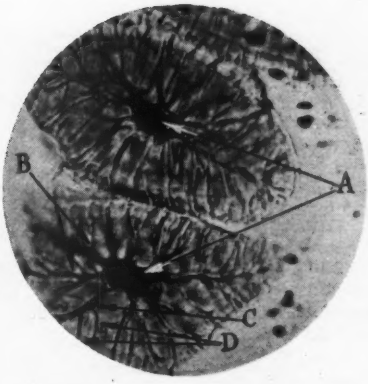

Fig. 119. — Coconut shell: elemental tracheid of nearly spherical shape. Mag. 650 diameters.

than was the case in the previous example. but it will also be noticed that the diameter of the channels is much the same as in the larger specimen. The necessity for this is obvious, as we have seen, the channels of each tracheid are continuous with those of all the surrounding elements, whereby a communicating system of channels exists throughout the structure of the shell, and the inefficiency resulting from variations in diameter of this system from tracheid to tracheid needs no emphasis.

The difference in size of these elements is interesting and is in all probability due to restricting influences coming into play during the early development of the shell, thus hindering the growth of the tracheid. This is also one of the reasons for differences in shape, which results in all shapes of tracheid from round to fibrous. This is well illustrated by reference to Fig. 118, showing one of the longer elements at a magnification of 650 diameters, in which we see clearly the great length of the vessel as compared with its diameter.

A feature which is common to all these elements is the manner in which the vestiges of the original cavity persist in the fully developed structure. In this case it is shown at "A" and represents what remains of the internal space of the original cell, which would possess a more or less spherical shape. As can be seen, this has suffered considerable modification which has greatly elongated the cell, resulting first in the tubular thin-walled tracheid giving way to the massive thick-walled structure seen here, possessing the long, thin, central cavity shown at "B"; the pit channels are again clearly seen in the usual radial arrangement.

Now examine some of the "nearly" spherical elements. Two of these, together with a portion of an elongated element, are shown in Fig. 119, this being a photomicrograph of the elements stated, again at 650 diameters.

On examining the elongated specimen, we see the structure to be very similar to the previous example, but if we examine the other two specimens we are confronted with a somewhat different structure, inasmuch as the central cavity still exists in, more or less, its original form as shown at "A." It is obvious that during the development of tracheids such as this, structural modifications will be necessary in order that the continuous and intercommunicating system of channels may be uninterrupted. This is accomplished by the development of subsidiary elongated cavities communicating

Table 1

Material	Surface Resistivity (megohms)		Volume Resistivity (megohms)		Breakdown (volts/mil.)
	Dry	After immersion in water.	Dry	After immersion in water	
Resin 50% Wood Flour 50%	1.2 × 10⁵	4.2 × 10⁴	1.04 × 10⁴	3.3 × 10⁴	47
Resin 50% Shell Flour 50%	1.48 × 10⁵	9.2 × 10³	4.6 × 10⁵	3.56 × 10⁵	104.6

with the main cavity at the centre. These are more clearly seen in the lower of the two spherical elements and are annotated at "B."

It will be noticed that the branch cavities take a straight path to the outer surface of the element when, no doubt, they continue their course by "lining up" with channels or similar branches in neighbouring elements. These branches of the main cavity are, however, too few in number to form an efficient irrigation system for the mass of the cell, and hence we see the development of pit channels branching off them in the same way as they do in cases where there is a long central cavity. At "C" we notice one of the subsidiaries of the main cavity, from which two channels branch out and make their way to the peripheral surface of the element. These are shown at "D."

The significance of the system of channels running through the structure of these elements may not at first sight appear obvious, but when it is realized that this intricate system of ducts may, under the right conditions, be filled with resin during the moulding operation, or preferably before, by pretreatment of the fillers before incorporation in the main resin mass, it will be appreciated how the main resin mass will interpenetrate the fillers, thus bringing about greater homogeneity and strength to the finished product. One might argue to the effect that wood flour particles also possess a somewhat similar structure by virtue of the pitting of tracheid walls; this is true, but it must be borne in mind that the actual walls are considerably thinner in the case of wood tracheids than are those found in the shell elements, as a result of which the pits have no length at all when compared with that of the shell tracheids. Likewise in the wood tracheids each pit is an individual entity and has no direct communication with pits in other tracheids, whereas the pits in the shell tracheids are each part of an extensive network of tubes or ducts bringing each element into direct communication with adjacent members.

It will also be seen that, assuming the complete filling of all the ducts in all elements of the filler, in the case of a moulding containing coconut shell fillers, the arrangements of the ducts in each particle is such as to tend to produce a very much more even stress distribution in the filler particles than would be the case with wood flour. This would, in some measure, account for the higher impact strength exhibited by shell flour filled mouldings. In the coconut shell elements we have what promises to be a useful filling agent, whereby the more important strength characteristics are better than those found in wood fillers, by virtue of it affording means whereby more even stress distribution is brought about in the moulding. Due to its massive structure and heavy lignification, which in all probability contains considerable quantities of reactive lignin, it is highly likely that an actual surface bonding between the filler particle and the resin takes place, which will be appreciated as being of great assistance in conferring strength to the final products.

The shell particle is, however, much more brittle than the wood particle and hence possesses less elasticity; this, of course, being due to the presence of a considerable proportion of lignin and the

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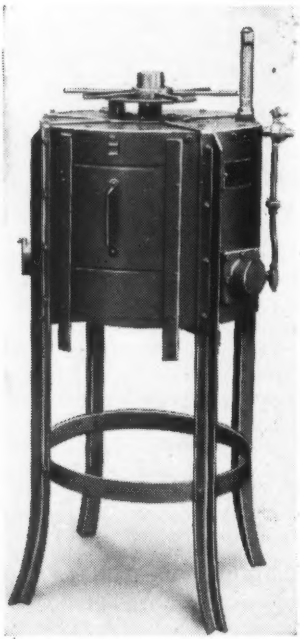

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manner in which it is laid down. It is highly probable that in spite of everything else, this characteristic is the cause of the inferior tensile strengths shown by this filler, also it accounts in some measure for the apparently anomalous flow characteristics imparted to the finished moulding powder.

With regard to the electrical characteristics produced by coconut-shell flour filler, they seem to hold promise of a definite improvement. Schueler* quotes the comparative figures shown in Table 1.

From these figures we see that the coconut-shell filler shows a distinct improvement on the wood flour, although it must be borne in mind that details of the resin and the species of wood and mesh size are lacking, in consequence of which no real comparison may be drawn. Likewise, we have no information as to moulding conditions, etc., but assuming that these latter and the resin to be the same in each case, we are justified in using the information given to form a general comparison giving a rough idea of the merits of these two types of fillers.

The surface resistivity in the dry condition shows a gain of some 20 per cent. for the shell-filled material over the wood-flour filled powder, but when we examine the same property measured after immersion in water, we are faced with an unexpected drop of about 25 per cent. for the shell filled, and in view of the fact that in the same group of figures Schueler gives the moisture absorption of the shell-filled material as being "52 mg" as against "86" shown by the wood-filled material, an anomalous situation is seen to exist. However, taking into consideration that, apart from the bare statement of figures, no other information is vouchsafed regarding the test conditions, etc., for the measurement of the surface resistivity after immersion, we would be justified in treating this particular result with a certain amount of reserve.

This does not mean to infer that the result is wrong, for it is quite possible that it may be due to some quite unforeseen circumstance. It does, nevertheless, indicate the necessity for further investigation on the subject.

Continuing our examination of the electrical properties, we see that in the case of volume resistivity, measured dry, the coconut-shell filled material shows a gain of about 25 per cent. on the wood-filled powder and a gain of some 10 per cent. in the case of the same measurement taken after immersion. Likewise, in the case of breakdown voltage, the shell-filled material shows a gain of over 50 per cent. Taking these figures as a general indication, we may conclude that the use of coconut shell as a filler would tend to produce better electrical properties than wood flour, all other things being equal, particularly so if the shell flour could be produced by the masceration methods previously outlined, because we would then have some measure of control over undesirable constituents, such as the very fine dust and aggregates of cellulose previously shown to exist in powders produced by mechanical means only.

(To be continued)

* Schueler, "Coconut Shell Products and the Plastics Industry," "Plastics," February, 1946.

BRITISH BUTTON TRADE.—We have received a copy of "British Buttons," a new publication issued jointly for the British Button Manufacturers Association and the Casein Button Manufacturers Association by E. H. Jones (Machine Tools), Ltd., of Edgware Road, The Hyde, London, N.W.9. It is intended to become the official organ of the button industry, and is unique in that it is the only publication of its kind throughout Europe. One of the articles in the July issue deals with the German casein plastics industry, and is based mainly on the B.I.O.S. report, which was published by the Stationery Office, following the investigations carried out by Mr. F. N. Pratt, of B.X. Plastics, Ltd., and Mr. R. Schrecker, of O. Murray and Co., Ltd., who visited Germany in October and November of last year. Mention is made of tumbling barrels for casein articles. For the first barrelling, Italian pumice is used, for the final polish, leather and textile scrap soaked in oil, with chalk. The present production of buttons in Germany utilizes phenol-formaldehyde, urea-formaldehyde, polystyrene, and casein plastic sheets. Production is by injection moulding, turning, and tumbling.

PRODUCTION NEWS

Raw Materials, New Plant, Works Organization, Control Apparatus, Research, Personal and Trade Notes

PILKINGTON BROTHERS, LTD.—This company have just published a brief account of their many activities during World War II, in which there is reference to work on plastics. At the Ashdown factory there was a swing-over during the war from general-purpose materials to those compatible with explosives. A large number of the mouldings were required to be in contact with the explosives in shells, bombs, mines, etc. They were used largely in connection with fuses, smoke boxes, detonators, for filling ammunition, for practice bombs, transit covers for aero-engines, and grenade housings; also for the combinations which go to make wireless receiving and transmitting sets. In addition to mouldings, one shop was turned over to the forming and fabrication of "Perspex," to act as an overflow shop when pressure of the aircraft programme was at its height and when there was considerable danger of the works of existing fabricators being damaged by enemy action. The main job here was the production of a large fairing for the Lancaster bomber, approximately 6 ft. by 4 ft. by 2 ft. 6 ins., assembled from nine pieces, separately formed, and then cemented together.

C. W. QUARRELL AND CO., LTD., are engaged in the moulding and fabrication of thermoplastics at St. Michael's Works, Great Western Terrace, Yeovil. Mr. C. W. Quarrell, the managing director of this new company, has been interested in plastics for many years. During the war he became assistant sub-contracts officer at Westland Aircraft, Ltd.

ARMORIDE, LTD., of Rook Lane, Dudley Hill, Bradford, are to make new types of plastic-coated cloth at premises they have acquired in Grove Mill, Earby. During the war the company maintained a large production of these cloths for aeroplane coverings, barrage balloons, Service helmets, groundsheets, etc. The company is a subsidiary of Associated Weavers, Ltd., Bradford.

IMPERIAL CHEMICAL INDUSTRIES, LTD., announce that the Departments of their Southern Region Sales Office, now remaining at Mill Hill, are to return to London, where the main office has been located since July 22. The Engineering Trades and Metals Departments will be at Gloucester House, 149, Park Lane, W.1 (Tel. Grosvenor 4020), on and from September 1. The other departments, i.e., Agricultural, Dyestuffs, Household Products and Distribution, including Packages and Accounts, are to move on September 13.

AERO RESEARCH, LTD., Duxford, Cambridge, have sent us a copy of their new leaflet on Aerolite 300, which combines the simplicity of mineral and vegetable glues with the quick-setting properties and resistance to water afforded by a synthetic glue. Aerolite 300 is claimed to be the only adhesive which fulfils the requirements of B.S. 1204 for gap-filling glues.

GENERAL ELECTRIC COMPANY, LTD., have introduced a new process which weaves metals for decorative grilles in radio receivers. Known as "multi-weaving," the process can be applied to plastics, wood and rubber, in addition to metal.

INDIAN EXPORT CONTROLS.—The Government of India has announced that articles made wholly or mainly of plastic materials, including Bakelite, have now been freed from export controls.

BRITISH TECHNICAL PLASTICS, LTD., of Newcastle, have acquired premises at Whitley Bay, where it is proposed to manufacture plastics for the dental, optical and medical professions.

BRITISH PLEXON, LTD., of which British Ropes, Ltd., are the principal shareholders, are to set up a factory at Leith, Scotland, where they will manufacture coat weaving and braiding yarns with plastics to make them waterproof. The resulting fabric will be used largely for clothing.

PORTLAND PLASTICS, LTD.—Mr. W. H. Moss, B.Sc.(Hons.), F.R.I.C., late of British Celanese, Ltd., has joined the personnel of Portland Plastics, Ltd., as factory general manager. Mr. D. L. C. Jackson, F.R.I.C., late of British Nylon Spinners, Ltd., has become control chemist of the same company.

TRADING WITH THE ENEMY REGULATIONS.—The Foreign Office and Board of Trade announce that by an Order (S.R. and O. 1946 No. 1041), which became effective on July 9, all existing lists of persons specified as enemy by the Board of Trade under Section 2 (2) of the Trading with the Enemy Act, 1939, have been revoked. As part of the continuing control, attention is still to be drawn to S.R. and O. 1946 No. 1039 and 1040, the effect of which is to vest in the Official Custodian certain property in the United Kingdom belonging to any persons whose name was included in the Statutory List current immediately before its revocation.

RENOLD AND COVENTRY CHAIN CO., LTD.—On August 26 this company is introducing for all employees a five-day working week at their works in Manchester and Coventry. The central office at Manchester and branch offices will also be closed on Saturday mornings.

LACRINOID PRODUCTS, LTD.—Mr. Hugh R. Francis, O.B.E., has been appointed joint managing director with Mr. H. E. Baum.

DR. H. W. CHATFIELD, B.Sc., F.R.I.C., A.M.I.Chem.E., has established a private practice as a consulting and applied research chemist, at 13b-15b, Stafford Road, Croydon, Surrey. He will continue to act as a consultant for Jenson and Nicholson, Ltd. In addition, he will be devoting his time and experience to the evaluation and exploitation of all raw materials and intermediates which have any application to surface coatings.

RUBBER IMPROVEMENT, LTD., have opened a Northern Area office at 196, Deansgate, Manchester, 3 (Phone: Blackfriars 7380). The manager of this office is Mr. R. G. N. Latham.

IMPORTS FROM UNITED STATES.—The Board of Trade announce that arrangements have now been made whereby token imports of certain goods will be admitted from the United States at the rate of 20 per cent. per annum by value of American manufacturers' pre-war trade with the United Kingdom in the goods in question. These goods include "plastic buttons." Applications for licences will be considered only when accompanied by evidence from the United States Office of International Trade and Department of Commerce identifying the goods which are the subject of the application with the output of a specified American manufacturer.

POLISHING CLOTH for use on transparent plastic panels is the subject of one of the series of material specifications (D.T.D. 763, Stationery Office, price 6d.) issued by the Ministry of Supply to meet limited requirement not covered by any existing British Standard Specification. As regards the fabric used as the basis of these cloths, the specification lays down requirements for quality of yarn, construction, finish, width, weight, freedom from impurities, residue on ignition and selection of test samples. Methods for the determination of weight, chloride and sulphate content, and residue on ignition are given as Appendices.

SYNTHETIC RUBBER IMPORTS.—Board of Trade returns for imports and exports during June show that imports of synthetic rubber at 1,400 tons were the lowest since February.

OPERATION OF GAS PRODUCERS.—The Ministry of Fuel and Power has now added to their series of fuel efficiency bulletins a manual on the operation of gas producers, designed to appeal not only to the operative but also the producer superintendent. One of the points stressed is the importance of employing a producer superintendent and of ensuring adequate liaison between those responsible for the operation of the plant and those using the gas produced by it. Copies of this publication (Fuel Efficiency Bulletin No. 44) are free on application to the Regional Offices of the Ministry of Fuel and Power.

EXAMINATION IN SALESMANSHIP.—The Incorporated Sales Managers' Association, 23, Bedford Square, London, W.C.1, announce that their next examination in salesmanship will be held in London and various provincial centres on October 26. Entry forms must be completed and returned before September 30. This examination is not accepted as exemption from Part II of I.S.M.A. final examination.

MR. G. HAIM has relinquished his position as chief chemist of the Arc Manufacturing Co. in order to join Rockweld, Ltd., of Croydon. Mr. Haim will take charge of the development of special electrodes for arc welding and will also develop the gas welding of thermoplastics.

PATENT REVIEW

The following abstracts have been made from specifications at the Patent Office, with the permission of the Controller of H.M. Stationery Office. Complete specifications can be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2, price 1/- each.

B.P. 577,828. Application date: 3.7.42. Accepted: 3.6.46.

Improvements in or relating to Electric Insulating Materials. T. R. Scott and A. A. New. To: Standard Telephones and Cables, Ltd.

Rubber substitutes suitable for covering communication cables used at telephone frequencies, consisting of a mixture of plasticized polyvinyl chloride, plasticized Thiokol, mineral fillers and a vulcanizing agent.

B.P. 577,829. Application date: 3.7.42. Accepted: 3.6.46.

Process of Reclaiming Rubber. F. H. Cotton and P. A. Gibbons.

B.P. 577,830. Application date: 3.7.42. Accepted: 3.6.46.

Removal of Metal Wire from Vulcanizing Rubber such as the Rims of Tyre Covers. F. H. Cotton and P. A. Gibbons.

B.P. 577,860. Application date: 30.11.42. Convention dates (U.S.A.): 29.8.41 and 30.8.41. Accepted: 4.6.46.

An improved manufacture of Electrical Insulating Compositions. To: The Standard Oil Development Co.

Insulating material with good electrical properties and high modulus of elasticity and resistance to cold flow, obtained by compounding a mono-olefinic polymer with a copolymer (of styrene), and a minor proportion of polyisobutylene, polypropylene or a methacrylic ester.

B.P. 577,861. Application date: 1.1.43. Convention date (Canada): 21.10.42. Accepted: 4.6.46.

Improvements in the Polymerization of Vinyl Acetate in Emulsion. H. M. Collins and N. Kiar. To: Shawinigan Chemicals, Ltd.

Stable aqueous emulsions of polyvinyl acetate obtained by emulsifying vinyl acetate in water in the presence of a partially hydrolized polyvinyl acetate and subjecting this emulsion to refluxing in the presence of a peroxide catalyst.

B.P. 577,866. Application date: 25.1.43. Accepted: 4.6.46.

Improvements relating to Film-forming Materials and Products formed therefrom. J. H. Rooney, J. H. Sharphouse and P. R. Hawtin. To: British Celanese, Ltd.

Process for making films which are water insoluble and resistant to mustard gas. The process comprises treatment of a film of polyvinyl alcohol with a homogenous liquid medium consisting of an aldehyde, an acid catalyst, water and a non-solvent for polyvinyl alcohol; acetalization is continued until the stage is reached where the film becomes insoluble in boiling water.

B.P. 577,867. Application date: 2.2.43. Accepted: 4.6.46.

An improved Electrical Insulating Compound. G. M. Hamilton. To: Callenders Cable and Construction Co., Ltd.

Insulating compound which can be poured when hot and which sets on cooling, consisting of a mineral oil, polyethylene and a rubbery hydrocarbon polymer soluble in the mineral oil, e.g., naphthene base oil—solid polyethylene—polyisobutylene.

B.P. 577,868. Application date: 3.2.43. Accepted: 4.6.46.

Improvements in or relating to the Regeneration of Vulcanized Rubber. D. F. Twiss, A. J. Hughes and P. H. Amphlette. To: Dunlop Rubber Co., Ltd.

B.P. 577,871. Application date: 13.2.43. Accepted: 4.6.46.

Improvements in or relating to Synthetic Rubbers. M. M. Heywood. To: Firestone Tyre and Rubber Co., Ltd.

Refers to synthetic rubbers of the butadiene class. Plastic flow and tackiness of unvulcanized butadiene rubber are increased by the inclusion of an agent which augments tackiness and a wetting agent which reduces the surface tension between rubber and the tackifier. The wetting agent is a resin soap or a sulphonated alcohol and the tackifier is resin oil or pine tar.

B.P. 577,872. Application date: 13.2.43. Accepted: 4.6.46.

Improvements in or relating to the Manufacture of Synthetic Rubber Articles. M. M. Heywood. To: Firestone Tyre and Rubber Co.

Method of dispersing solid compounding ingredients in butadiene rubbers by incorporating a wetting agent (monoethanolamine

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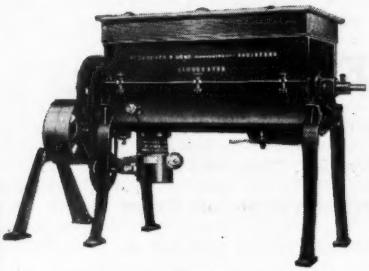

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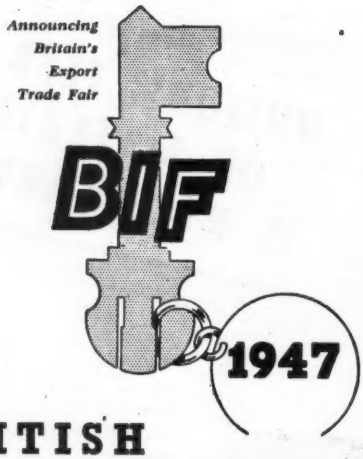

BRITISH INDUSTRIES FAIR

The first post-war British Industries Fair will be held in London and Birmingham from 5th-16th May, 1947. The 1947 Fair will provide a great opportunity for expansion of Britain's Export Trade and intensive publicity campaigns will be launched to attract buyers from all parts of the world.

Plastics and Moulded Products United Kingdom manufacturers of Plastics and Moulded Products will be exhibiting in the London Section of the Fair. Members of the British Plastics Federation should return *completed* application forms to the Secretary of the Federation, 47-48 Piccadilly, London, W.1.

APPLICATIONS FOR SPACE

Since the demand for exhibiting space will be great, applications must be received at the earliest possible moment. Full details and forms of application are obtainable from the Board of Trade, Export Promotion Department, 35 Old Queen Street, London, S.W.1

stearate or cyclohexyl ammonium cresylate, a phenol or substituted phenol).

B.P. 577,875. Application date: 11.3.43. Convention date (U.S.A.): 27.4.42. Accepted: 4.6.46.

Method of Stabilizing a Plastic Composition comprising Ethyl Cellulose. W. W. Koch: To: Hercules Powder Co.

Refers to the stabilization of ethyl cellulose compositions which retain their viscosity, flexibility and colour after exposure to heat, light, or weathering, by incorporating with the ethyl cellulose a phenol having a carbon linkage para-substituent and an oxygen linkage ortho-substituent as stabilizer (syringic acid, vanillyl alcohol, para-tertiary butyle catechol).

B.P. 577,876. Application date: 15.3.43. Accepted: 2.4.46.

Improvements in or relating to the Manufacture of Chlorinated Hydrocarbons. W. N. Howell. To: Imperial Chemical Industries, Ltd.

Refers particularly to the manufacture of vinyl chloride and comprises the reaction of vinyl chloride with excess chlorine in solution in 1.1.2—trichloroethane in the presence of a chlorination catalyst and subsequently treating the 1.1.2—trichloroethane with aqueous alkali at elevated temperature in order to vaporize the vinyl chloride so produced and subsequently condensing these vapours.

B.P. 577,943. Application date: 2.12.41. Accepted: 6.6.46.

Improvements in or relating to Electric Insulating Materials. M. C. Field. To: Standard Telephones and Cables.

The extrusion of an insulating material containing polystyrene and one or more rubberlike materials may be greatly facilitated by adding solid polyethylene in proportions between 5 and 20 per cent. to the final mixture.

B.P. 577,953. Application date: 23.10.42. Accepted: 6.6.46.

Improvements in Apparatus for subjecting Matter to Electrical Oscillations of Radio Frequency. L. C. Stenning. To: General Electric Co., Ltd.

Method of preventing frequency shift of a high-frequency generator used for the heating of plastics, etc. Comprises two or more bend-pass filters which operate an adjustable tuning condenser in the work circuit when the frequency of oscillations is shifted due to change in the electrical properties of the material to be treated (change in capacity due to compression, etc.). The output of the filter or filters is used to operate a motor which controls the tuning condenser and thus resets the work circuit to the original frequency.

B.P. 577,960. Application date: 28.2.44. Accepted: 6.6.46.

Manufacture of Sheets, Films, Foils, Pellicles or the like. E. Geisel. To: Transparent Paper, Ltd.

Relates to films, sheets, etc., made from regenerated cellulose and comprises treatment of the freshly formed film or sheet prior to drying through aqueous solution or dispersion containing a melamine formaldehyde resin.

B.P. 577,997. Application date: 4.2.44. Accepted: 11.6.46.

The Production of Tubes from Thermoplastic Materials. R. L. Stephens and W. O. Steel. To Imperial Chemical Industries, Ltd.

Method of producing thick-walled tubes from thermoplastic materials by means of welding, through high-frequency electric fields. The tubes can be built up from extruded concentric sections, or, alternatively, from sheet wrapped round a former. In both cases inner and outer cylindrical electrodes are provided between which high-frequency heating and welding takes place. Materials quoted: polyvinyl chloride, polymethyl methacrylate, polyhexamethyline diamine adipamide, cellulose acetate and shellac.

B.P. 578,012. Application date: 11.3.43. Accepted: 12.6.46.

Improvements in and relating to the curing or vulcanization of Chloroprene type Synthetic Rubber-like Materials. W. Baird, B. J. Habgood, D. A. Harper and J. A. Hendry. To: Imperial Chemical Industries, Ltd.

B.P. 578,052. Application date: 22.2.44. Convention date (U.S.A.): 24.5.43. Accepted: 13.6.46.

Improvement in Combination Plastic and Metal Building. To: Tennessee Coal, Iron and Railroad Co.

B.P. 578,079. Application date: 29.7.41. Accepted: 14.6.46.

Improvements relating to the Manufacture of highly polymeric Substances. J. R. Whinfield and J. T. Dickson.

Refers to polymeric esters of phthalic acid with glycols.

B.P. 578,083: Application dates: 16.4.43 and 12.5.44. Accepted: 14.6.46.

Improvements in or relating to the Manufacture of Polymerizable Products from Hydrogenated Naphthalene and of Resins made therefrom. W. I. Jones and R. Hutt. To: Powell Duffryn Associated Collieries, Ltd.

Manufacture of unsaturated polymerizable compounds of styrene and indene, comprising treatment of hydrogenated naphthalene in the absence of added hydrogen and in the presence of a catalyst at a temperature above 200 degrees C. and at normal pressures. The hydrogenated naphthalene is subsequently distilled. During the fractionation process an inhibitor such as quinol or catechol is added. The product so obtained is then subjected to polymerization by treating it with benzoyl peroxide.

B.P. 578,086. Application date: 30.4.43. Accepted: 14.6.46.

Manufacture of Butadiene. G. M. Henderson. To: Imperial Chemical Industries, Ltd.

Manufacture of butadiene by heating ethylene in the absence of iron or nickel to a temperature between 750-900 degrees C. for not more than 2 secs., cooling the bases so obtained and subsequently isolating the butadiene.

B.P. 578,148. Application date: 10.11.43. Accepted: 17.6.46.

Improvements in and relating to the Water-proofing of Casein Formaldehyde Plastics. J. B. Speakman and J. L. Stoves. To: Erinoid, Ltd.

Water-proofing of preformed casein formaldehyde plastics by coating or depositing these plastics with synthetic resins of the phenol formaldehyde type, or by treating them with styrene or other vinyl compounds, so that a polymeric resin is formed in situ.

B.P. 578,209. Application date: 17.5.44. Accepted: 19.6.46.

Improved Process of Manufacture of Polymers from Acrylonitrile. R. G. R. Bacon and L. B. Morgan To: Imperial Chemical Industries, Ltd.

R.P. 578,214 Application date: 21.6.44 Accepted: 19.6.46.

Manufacture of Rubber-like Plastic Material. J. L. Parker. To: E. I. Du Pont de Nemours.

Refers to the polymerization of 2-chloro-1:3 butadiene or 1:3-butadiene in aqueous emulsion in the presence of from 0.1-3.0 of monophenylphosphine or monobutylphosphine.

B.P. 578,229. Application date: 2.2.24. Accepted: 20.6.46.

New Resinous Condensation Products. W. Charlton and J. B. Harrison. To: Imperial Chemical Industries, Ltd.

Resinous condensation products suitable for oil or stoving varnishes by heating hexame thoxyme thylmelamine and a butylated p-tertiary-butylphenoformaldehyde product in the presence of acidic condensing agents.

B.P. 578,233. Application date: 14.3.44. Accepted: 20.6.46.

Expanded Rubber Company Improvements in or relating to the Production of Gas Expanded Ebonite. A. Cooper.. To: Expanded Rubber Co., Ltd.

B.P. 578,255. Application date: 8.12.44. Accepted: 20.6.46.

Improvements in or relating to Egg Cups. J. Johnston. To: Universal Plastics, Ltd.

Moulded egg cups.

B.P. 578,264. Application date: 10.12.41. Accepted: 21.6.46.

A method of producing Cellular Resin Materials. N. A. de Bruyne.

A urea-formaldehyde condensation syrup is mixed with a modified hardener (an aniline formaldehyde condensation product dissolved in hydrochloric acid or mixed with ammonium chloride) and heated. The ultimate purpose is to produce "sandwich" panels (expanded resin between plywood sheets).

B.P. 578,266. Application date: 19.1.42. Accepted: 21.6.46.

Polymerized Product and Method of Making same. To: Pittsburgh Plate Glass Co.

Preparation of infusible insoluble resins by reacting polymethylmethacrylate with crotyl alcohol or allyl alcohol under heat and subsequent polymerization in the presence or absence of heat, light and catalysts.

B.P. 578,286. Application date: 22.11.43. Accepted: 21.6.46.

Improvements in or relating to the Production of Cellulose Ethers. J. H. Sharphouse and J. Downing.

B.P. 578,404. Application date: 2.7.42. Accepted: 27.6.46.

Improvements relating to the preparation of Low Density materials from Viscose Sponge. J. I. Jones.

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B.P. 578,405. Application dates: 6.8.42 and 15.7.43. Accepted: 27.6.46.

Improvements in or relating to the Production of Vinyl Esters. J. J. P. Staudinger, P. D. Coppock and D. J. Hadley. To: Distillers Co.

Refers to the production of vinyl acetate from acetylene and acetic acid in vapour phase in the presence of a catalyst (zinc or cadmium compounds supported on activated alumina).

B.P. 578,454. Application date: 3.4.44. Accepted: 28.6.46.

Improvements in or relating to Laminated Material. To: Imperial Chemical Industries, Ltd.

Bonding of self-sustaining, non-vulcanizable films of nylon, regenerated cellulose, cellulose esters, polyvinyl alcohols and polyvinyl acetate to rubber-like vulcanizable copolymers of butadiene by means of an adhesive composition containing a polyvinyl butyral, resin-forming ingredients (polyhydric phenol, an aldehyde and a basic polymerization catalyst) dissolved in a volatile solvent.

B.P. 578,482. Application date: 24.6.43. Accepted: 1.7.46.

Improvements in or relating to the Regeneration of Vulcanized Synthetic Rubber-like Materials. P. H. Amphlett, A. J. Hughes and D. F. Twiss. To: Dunlop Rubber Co., Ltd.

Plasticization of butadiene rubbers by mechanical treatment comprising disintegration of the material, impregnation with a mixture containing a softening agent (pine tar, pine oil, soumarone resins, naphtenates), a plasticizer with a mercapto group and an aromatic organic acid (benzoic acids or its substitutes). The material is subsequently worked on calenders.

B.P. 578,484. Application date: 3.3.44. Accepted: 1.7.46.

Manufacture of Improved Alkyd Resin Coating Compositions. R. K. Iler, G. H. Latham and I. W. Robinson. To: E. I. Du Pont de Nemours and Co.

Alkyd resin coating compositions with good colour stability, satisfactory hardness and durability produced by incorporating organic solvent soluble esters of polysilicic acid.

B.P. 578,485. Application date: 22.3.44. Accepted: 1.7.46.

Improvements in and relating to the Manufacture of Hollow Articles of Bonded Fibrous Laminæ.

B.P. 578,504. Application date: 18.12.44. Accepted: 1.7.46.

Improvements in the Production of Cellulose Esters. To: British Celanese, Ltd.

Concerns production of mixed organic esters of cellulose (cellulose acetate-butyrate, etc.), suitable for moulding.

B.P. 578,513. Application date: 13.3.42. Accepted: 2.7.46.

Improvements in or relating to the Manufacture of Expanded Thermoplastic Resinous Compositions. A. Cooper and D. E. Partington. To: Expanded Rubber Co., Ltd.

Refers to cellular thermoplastic composition prepared by impregnating a stiff dough of plasticized resin with an inert gas under pressure, expanding the dough under reduced pressure, and removing the plasticizer at a temperature below the softening point of the resin. The material is supported during and after expansion until hard enough to retain gas. Specific examples quoted: polystyrene, polyvinyl acetate, cellulose acetate.

B.P. 578,525. Application date: 10.1.44. (Addition to B.P. 578.513.) Accepted: 2.7.46.

Improvements in or relating to the Manufacture of Expanded Thermoplastic Resinous Compositions. A. Cooper and D. E. Partington. To: Expanded Rubber Co., Ltd.

Improvement of B.P. 578,513 consisting in a remoulding operation of the expanded and hardened thermoplastic material.

B.P. 578,540. Application date: 19.7.44. Convention date (U.S.A.): 19.7.43. Accepted: 2.7.46.

Improvements in and relating to Polyethylene Glycol Compositions. To: British Thomson-Houston Co., Ltd.

Polyethylene glycol compositions for use as temporary seals which break after contact with water, also suitable as a binder for pigments, etc., prepared by dissolving tartaric acid in molten polyethylene glycol, cooling the solution to 50 degrees C. and mixing it with an alkaline bicarbonate. Such compositions have a uniform rate of solution in water.

Planned Mould Maintenance Service Aids Economical Production

Section XXI

By W. M. HALLIDAY

In the present section concluding the study of insert feeding and retaining mechanisms applied to injection-type moulds, attention is devoted to an unusual mould design involving the use of long rods as inserts.

From the description and illustrations of this mould construction it will be noted that often it is mechanically and economically feasible to fashion a mould so that moulding is formed around the insert member, in such cases where the latter comprises a long rod, strip, or plate having a knob, handle, or arm member in plastic material moulded to it. In the examples chosen it will be seen that the metallic rod around which a knob has to be moulded is approximately five times the overall length of the plastic moulding thereon.

Two types of mould constructions will be illustrated. The first is a mould designed and constructed for hand feeding and location of a number of such rods. The second design is an adapted form of the first, providing for automatic feeding, location, and holding of a complete set of rods per moulding cycle.

As readers will doubtless appreciate, a considerable number of injection mould designs incorporating insert feed-mechanisms have now been considered and illustrated. Each type has been representative of a clearly defined class of mould construction. The examples discussed by no means completely exhaust the subject of insert feeding. The writer hopes, however, that although the subject has been far from adequately covered, enough will have been written to illustrate the great variety of successful mechanical arrangements which can be adopted for feeding, sorting and retaining a widely differing range of insert shapes and sizes. The author also hopes such designs will serve in this manner because they show the various ways in which conventional mould layouts can be adapted to impart insert feeding movements of the unique character described. This is an important point, incidentally, and well worth the closest study by the mould designer.

Very often it is held that to employ an automatic mechanical feed for inserts an entirely non-conventional type of mould construction will be necessary. This is not always so, since, as has been shown in earlier sections, it is often possible to embrace the insert feeding mechanism as a more or less distinct unit built on to the mould externally, thereby rendering it possible to employ standard mould constructions to a large extent.

Indeed, throughout this portion of the series and in all the examples selected for consideration, the present writer has held this aspect of the designer's problems in view, with the result that most of the constructions advanced have been typical of the practicability and certainly the ease of modifying standard mould constructions to that end.

In cases where the insert piece follows a uniform shape and in size is considerably smaller than the plastic moulding of which it has to form a part, little difficulty will be experienced in introducing such parts to the mould. Thus cylindrical components of short length, tubular parts, thin flat plates, rings, washers, and nuts, all of conventional shapes and sizes, offer little trouble.

When dealing with such types of inserts the chief obstacles lie in so fashioning the feeding mechanism to allow for economical production from multiple impression tools. Again, with such insert parts it is relatively simple to provide suitable housing and supports for retaining them in correct position during the moulding cycle without the risk of their becoming disturbed and misplaced by the flow of the incoming plastic material.

In all insert type mould constructions

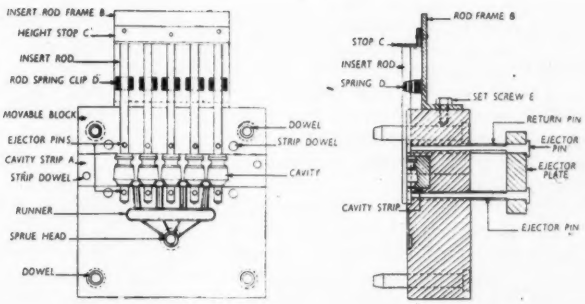


Fig. 1.

this by the way is an essential condition. Means will always have to be provided to prevent the insert part from being dislodged. Usually this is taken care of by allowing the insert to seat itself in a housing provided in the cavity wall or base. Where the insert is a threaded piece means will have to be provided to prevent the flow of plastic along the threads, and in this respect special provisions have often to be employed in the shape of detachable threaded sleeves screwed on to the projecting ends of inserts, or even a modification of the insert itself to provide a plain portion at the point needed for blanking off the flow of plastic material out of the cavity area.

An Unusual Insert Component

Very often in plastic moulding instances arise, where the insert component is of such a shape, or size, as to render introduction into the mould cavity somewhat difficult. Before leaving this subject of insert feeding mechanisms, etc., it may therefore prove helpful to deal with at least one example of awkwardly shaped insert to show the type of feeding and holding mechanism possible for effectively delivering such parts to their correct place at the proper time in each moulding cycle.

Turning now to the detailed description of the first mould and insert feeding design, which is shown partially in Fig. 1, it will be observed that the mould is a five-cavity tool, the moulded part consisting of a shaped cylindrical knob which is required to be moulded on to the end of a long rod of brass. It should be specially noted that the length of this rod is actually five times the overall length of the moulded knob; this, is fact, constituting one of the chief difficulties in devising an effective and neat feeding device for use with this mould.

As will be seen, the formation and lay-out of the five cavities is quite simple and in accordance with standard construction practice. The moulds have a flat parting-line, the cavities being formed within separate strips. One strip is fitted to each mould block, being made level with the parting-lines surface, and half the cavity cut into each strip as shown.

This method of construction possesses several favourable points which are worth noting. They are: (a) On cavities shaped similar to these, the requisite machining, polishing, etc., can be much more easily performed. (b) In the event of serious wear and loss of original shape of such cavities, renewal or correction is quite a simple and inexpensive matter in comparison to recutting of cavities out of solid blocks. (c) In the case of very large mould blocks, considerable machining difficulties might be encountered if the cavities were to be cut from solid, whereas with strip construction the necessary machining can usually be accomplished upon relatively small machines. (d) Some appreciable saving is also secured in respect of mould materials. In the case of strip type construction now recommended for this type of tool, it will

be quite an inexpensive matter to make the strips from high-grade die steel, compared with entire blocks made from such expensive materials as necessary if the cavities were to be cut from solid.

Whichever method of cavity formation is adopted, the arrangements for feeding and locating the insert will, of course, be identical.

The brass insert rods are specially treated before admission to the mould by the formation of a groove across one side at the point where the moulded knob is located. This groove is then filled with plastic material when the knob is formed, thus acting as a key to prevent rotation and endwise movement. The point to be watched in connection with this grooving is that no burrs or raised portions are left at the side of the groove to prevent the rod from sliding easily, otherwise snags may arise when the rods are being processed, through the feeding mechanism which will be dealt with more fully later.

Manual Type Feed of Rod Inserts

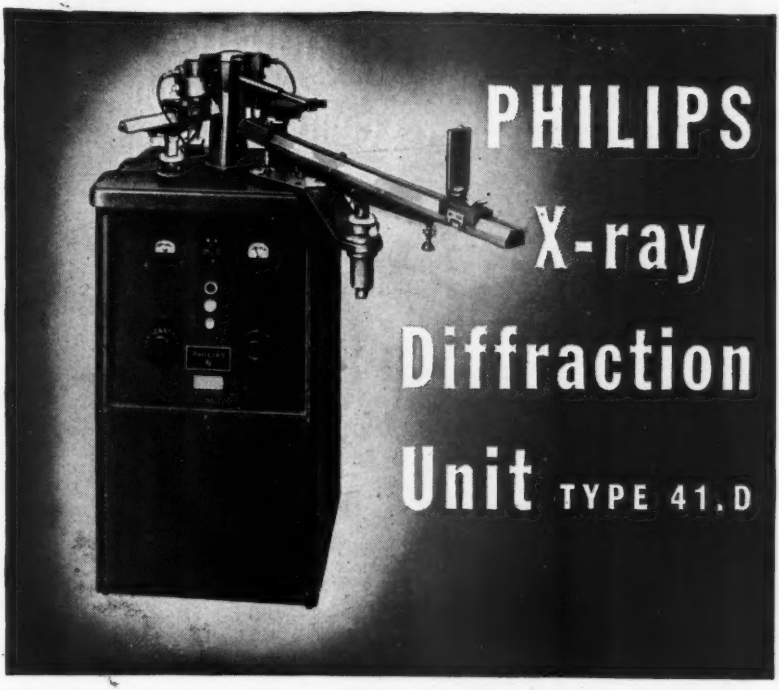
As will be noticed, the insert rods are fed into the cavity area in the vertical position. The reasons for this layout were several. In the first place, the shape of cavity with its undercut portions would have entailed considerable difficulties and complications in mould manufacture if located within one block at right angles to the parting line. Secondly, even had such a layout been feasible, the matter of feeding the five rods from the rear of the movable block would have presented several snags, and at the best would have resulted in a very drastic slowing-down of production. Thirdly, it would have required the insert rods to be brought into another plane at right angles to that of their issue from the magazine container before they could be entered into their respective seatings in the movable block. Fourthly, owing to the size of the mould, it was essential that any feeding device attached thereto should be kept as compact as possible, in order to allow for adequate opening of the blocks.

It should be explained that this mould, as shown in Fig. 1, was first designed and built for manual location and feeding of the five insert rods. In order that readers may better appreciate the difficulties to be overcome, and also the resulting advantages, it is proposed very briefly to describe the operation of the mould with this type of feed before dealing with the modified construction embracing fully automatic feed.

Fig. 1 shows two views of the movable block only, since all the requisite insert-feed arrangements are contained upon this member. The extreme left-hand view shows the parting-line surface of the block and the layout of the cavities, exactly half of each cavity being contained in this block. The parting-line surface view of the stationary block, not here shown, will be identical with that illustrated.

The cavity strip A is press-fitted into a rectangular slot in mould block, which extends right along the face as shown. Small dowels prevent the mis-positioning of this strip. The cavity strip is made exactly the same width as the overall length of the moulded knob portion. The remaining upper portion of the mould block is suitably machined to take the insert rods, which are shown in position in readiness for a moulding shot. It will also be seen that these holes extend below the cavity strip for a short distance, since the moulded knob had to be positioned a short distance from one end. The insert rods, when in place, rest upon the bottom of holes, as indicated. These locating holes are drilled when the mould blocks are clamped together, the parting line being made the centre line of the holes. This is important, since it is essential that when the blocks are parted precisely half a hole shall be formed in each part at the points where the insert rod is to be held.

Ejection is secured by means of two pins for each cavity, these being located in such a manner as to bear upon the brass insert rod above and below the cavity. The great advantage of this method is that no ejector-pin marks are thus formed on the surface of the finished moulding, upon which a smooth surface



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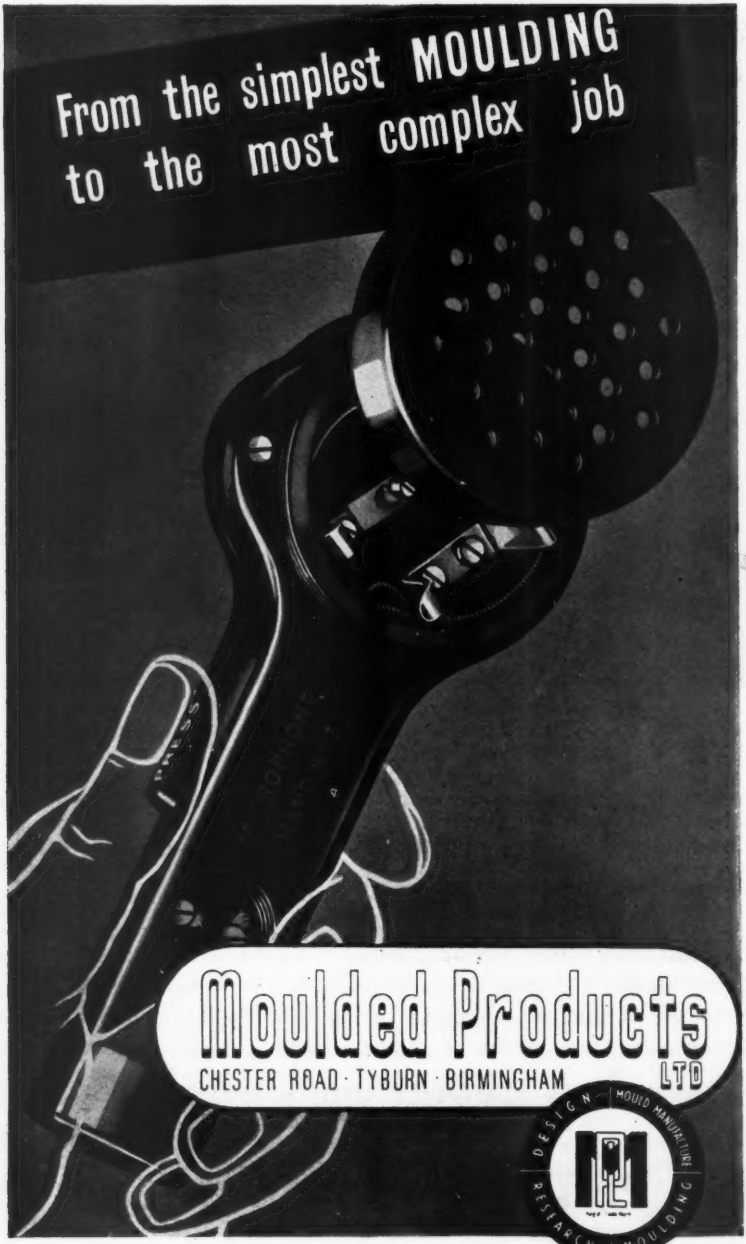
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finish was specially important. Usual-type return pins are also employed for bringing back the ejector plate and its pins to the moulding position when the mould blocks are closed.

Insert-holding Apparatus

Because of the hand-type feed employed, the equipment for holding the rods in place is extremely simple. A frame B, made from angle iron, is secured to the top edge of the movable block by means of set screws E. Attached to the top end of this frame is the height stop C, again consisting of a piece of small angle iron. This piece may be either riveted to the frame or preferably secured by small set screws, these latter being passed through elongated holes in the frame, thereby permitting a slight amount of vertical adjustment to the stop member.

The positioning of this height stop should be such as will allow a slight amount of clearance to the top of the rod when the latter is correctly located in place in readiness for an injection shot. The matter of 1/64 in. clearance will be quite sufficient.

Attached to the front face of frame B, near to the top edge of the mould block, are five vee-shaped spring clips. These members should be capable of gripping the rods smartly, yet allowing ready entry or removal of these parts. Each spring is located exactly on the vertical centre line of each mould cavity, as shown, so that the rods, when held therein, are brought in line with the holes in block.

Operation of Feeding Device

This form of feed is extremely simple to operate, as will be readily appreciated from the following brief description.

After an injection shot has been made, the movable block is withdrawn into its open position, the latter portion of this movement being employed to actuate the ejector plate and push the finished mouldings and their insert rods from the block.

With the mould block thus emptied, a set of five insert rods are then taken and clipped into place by means of the spring clips on frame. These members will be sufficient to hold the rods in place whilst the blocks are brought to the closed position. The last quarter of an inch of closing movement is utilized for moving back the ejectors to their moulding position by means of the four return pins. The housing holes in the blocks in which the rods reside are, of course, bored the same diameter as that of the rods, so that once the blocks are completely closed no space is left between the rod and its seating hole.

Advantages

Before leaving this design to consider the more intricate fully automatic type, it will be worth while noting a few advantages and drawbacks to this manually fed mould construction. The advantages are:—

(1) SIMPLICITY. From a mechanical point of view this is an extremely simple type of feeding device, its construction incurring but little additional expense.

(2) EASY TO MAINTAIN. Because of the simple nature of its construction and the few parts needed, the device is capable of being kept in efficient operating condition without any appreciable amount of maintenance supervision. There are no working parts in fact and little that can go wrong with normal careful usage.

(3) EASY MANIPULATION. With this arrangement it is a simple matter to place into position a set of rods since the spring clips serve to hold them in the correct vertical situation, whilst the holes in mould block give proper alignment and support to same even before the mould is closed.

(4) SAFETY. Given an operator having good powers of observation and interest, there is little risk of trouble arising due to mistakes, although a shot may be taken with one or more rods missing, or one incorrectly placed. Should this occur, much damage may be occasioned. Plastic material will find entry into the seating hole in blocks and may be forced outwards beyond the mould to cause injury to the operator. But the action involved in loading a set of rods is so simple that such occurrences are unlikely.

(5) POSITIVE LOCATION. The introduction and use of the height stop on the insert holding frame makes it very easy correctly to locate the rods in their seatings. Moreover, any tendency of the rods to move out of their seatings during the injection shot, by reason of the pressure of the incoming material, is entirely negatived by the positive stop provided. If the amount of clearance is maintained very small between the rod and the stop plate, it will easily be possible to maintain formation of the knobs along the rod within close limits.

Disadvantages

Regarding the disadvantages, these are:—

(a) SLOWING-DOWN OF PRODUCTION. Perhaps the chief drawback connected with this type of feed is the low rate of production possible due to the large proportion of time absorbed each cycle in the purely manual operations of placing the set of insert rods into position. As is well known, during actual production the parting-line surfaces of the blocks tend to become spattered after each shot with tiny particles of plastic material, which have to be brushed off before taking another shot. Some of these particles will be swept into the seating holes for the rods, entailing careful cleaning out at frequent intervals. This cleaning operation, added to that of actually placing the rods in place, will incur considerable time in relation to the other operations of the cycle. Much, of course, depends upon the skill and foresight of the operator.

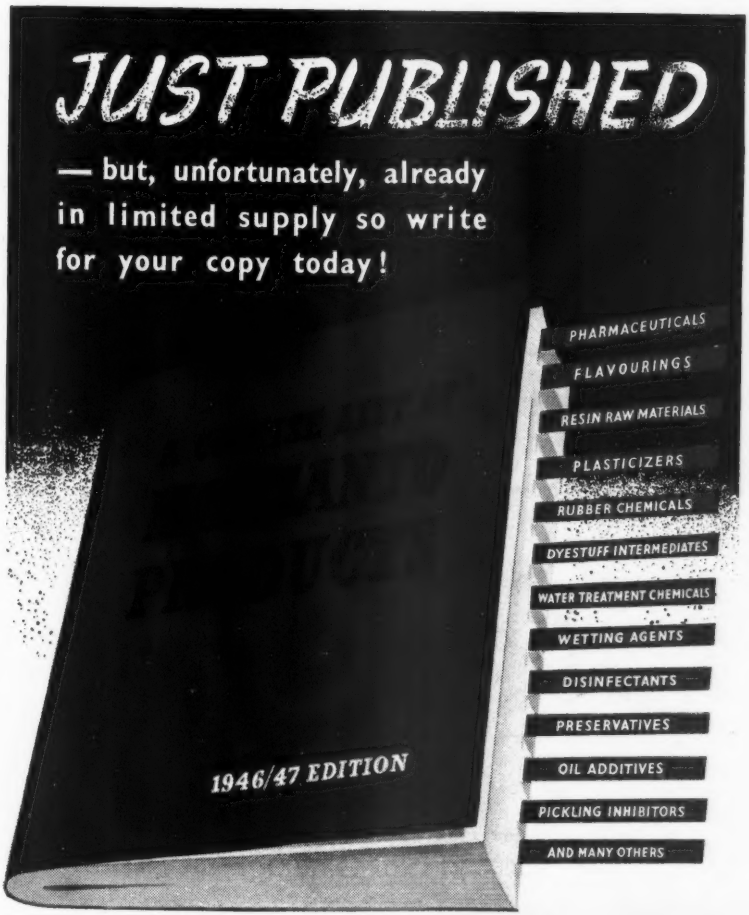
(b) CONTROL OF ROD SIZES. Very careful attention will have to be paid to the matter of rod length to ensure that no component oversize in this respect is introduced to the mould. Should this occur and an attempt be made to close the mould, serious damage may be wrought on the parting-line surface, edges of the cavity and rod seating holes due to violent trapping of the too long rod. Such occurrences can only be avoided by inaugurating and strictly maintaining a 100 per cent. inspection of rod length, coupled with a well-trained operator who has been made au fait with the danger and the consequences of allowing even one to be located within closing blocks.

Similar control will have to be maintained over rod diameters to ensure that no oversize part finds its way into the block seatings. The damage resultant from such an event would be that the blocks would not be completely closed leading to excessive flash formation, and, more important, the great clamping pressure imposed on the blocks would tend to enlarge the seating hole in which the oversize rod was positioned. This would mean that the next correct size rod introduced to this hole would leave a gap into which plastic material would find ingress, and the moulding would be marred by the presence of thin flash along the rod sides. The mould, too, would be damaged beyond correction, save than by enlarging the hole considerably in order to fit a bushing, or else to blank out the badly shaped hole by means of a block insertion and the machining of a new correctly sized hole. Either method involves considerable expense and withdrawal of mould from production for some time.

(c) EFFECT OF HEAT UPON SPRING CLIPS. One further drawback to be noted is that the vee-shaped spring clips employed for holding the insert rods will, in time, be affected by the heat of the mould. This will cause the spring steel to become fatigued, or to lose a certain degree of temper, with the result that rods will be insecurely gripped. This may not appear important, but it must be borne in mind that serious consequences may follow from a too loosely held rod if the latter is able to drop out of its seating and become jammed between the closing blocks. Extensive damage can thus be done to the parting-line surfaces of the blocks and the knife edges of the mould cavity destroyed.

Maintenance Services for Manually Fed Mould

Because of the extreme simplicity of construction and method of operation of this mould and its feeding mechanism, very little maintenance attention will be



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required. Such activities will be confined to the following points.

EJECTOR PINS. Since the ejector pins are arranged to impinge upon the insert rod, some regular attention will be necessary in order to ensure that none of the pins becomes loosened in the ejector plate and allowed to move forward so as to project into the seating holes for the insert rod. Were this to occur it would be difficult for the rod to seat down properly, with the result that, upon closing the mould blocks, either the ejector pin would become distorted, due to the end pressure, or the blocks would be unable fully to close, or the insert rod might be bent in endeavouring to seat itself completely in its housing. If the ejector pins were to be bent or mushroomed over at their operating ends, stiffened working and perhaps seizure of these members would develop speedily.

EJECTOR PLATE. For the above reasons it will be essential to ensure that the ejector plate is properly guided and constrained to move squarely to the block so that none of the ejector pins can thus become misaligned with the rod seatings. Similarly, the return pins for bringing back the ejectors to the moulding position must also be capable of maintaining the plate in correct relationship to block.

INSERT-ROD SEATINGS. With a mould of this design, which the writer has had in operation for some considerable time, it was very soon apparent that the seatings in each mould block were subject to considerable wearing effects. Upon investigation it was found such wear occurred at the edges of each hole, and it was ascertained as being due to the approximate positioning of the rods by the vee-shaped spring clips. This meant that when the blocks were closed each time the lower portion of the insert rods had to be brought in line with the seatings in each block. In cases where the entire mould blocks are not hardened it will be found necessary to employ small plates or sleeves let into the blocks in which the rod seatings can be machined and the whole plate subsequently hardened. Such a procedure also possesses the added merit of allowing easy and inexpensive replacements to be made to these essential locating points in the event of undue wear.

Slightly Modified Feeding Device for Inclined Insertions

Before leaving this example it will be of interest to know that by means of a very simple modification the writer was able to employ a similar feeding and positioning arrangement on a mould where the insert rods had to be entered into the mould cavity at a slight angle.

To obtain these provisions the frame was made substantially as described earlier, but, instead of having the spring clips to hold the rods, short slotted blocks were used. The slots in these blocks were made of sufficient width and depth to allow an insert rod easily to seat therein. These blocks were, of course, fastened permanently to the frame and set over at the requisite angle in respect to the mould block.

To seal off each slot in the set of blocks when each one had been loaded with its insert rod, a swivelling latch was secured on a stationary fulcrum to the frame and so arranged as to allow it to be swung over to a stop piece, and so closing each slot in the blocks, thereby preventing the rods from falling out of position whilst the mould blocks were being closed.

Briefly, the sequence of movements of this modified insert feed are as follows: After an injection shot has been made, the latch member closing the slots is first raised before the mould blocks are parted. This, then, allows the ejectors to operate safely when the blocks are opened. After the finished components have been ejected, the operator inserts a fresh complement of rods, then brings down the closure latch once more prior to closing the mould for the next shot. The chief point to be noted is that the closure latch must be raised immediately after injecting the material and before opening the mould.

Whilst this proved slightly slower in operation than the first design employing

spring clips, the extra surety and fool-proofing of the operation was deemed well worth while.

From this it will also be apparent that the device can be employed just as effectively, even though the angle of inclination of each rod is different. The holding frame and its slotted blocks would simply be adjusted to suit these differing angles, whilst the actual feeding would present no difficulties.

In cases where it is desired to employ cylindrical tubes instead of solid rods as the insert components, the feeding device just described can readily be adapted so as to deal with such parts. All that is necessary would be to equip the holding frame with suitable blocks or clips, and at the lower end of the seatings in the mould block to arrange for sealing plugs to be located to seal up the ends of the hollow tube, so that excess plastic materials could not find entry into bore of tube.

Where it is required to locate the plastic moulding on the extreme end of such a hollow tube, the bore may be safeguarded against being filled with material during injection by extending the sealing plug so as to pass well up into the mould cavity area. In this manner, when an operator loaded the movable block with a fresh set of insert tubes, each one would have to be passed on to the sealing plug first and then clipped into correct vertical position on the frame at top of block. The diameter of the sealing plugs would, of course, be sufficient just to fill the bore of tube. Such a simple modification was, in fact, used with signal success by the present writer some years ago, and the ability so to employ hollow tubes and maintain them free from plastic material presents innumerable possibilities in all kinds of products.

(To be continued)

DEPOSITION OF METAL ON PLASTICS

(Continued from page 475)

then completely exhausted and a current passed through the coil in order to heat the metal up to a sufficiently high temperature. The metal then vaporizes and settles on to the objects in the chamber. Aluminium can be dealt with by this process quite satisfactorily and it is also applicable to other metals.

This process has the advantage that the metal cloud settles on all surfaces exposed to it, whereas with the sputtering process, the metal is sputtered off from the electrode and tends to settle on that surface nearest the electrode. The same disadvantages, however, apply, namely, that the process involves expensive apparatus and is also expensive to carry out, although in this case a cheaper metal may often be used. The process, therefore, had applications for specific types of electrical components.

3. **Spraying, etc.** Apart from the vacuum process, it is possible to spray certain metals by atomizing them in an oxy-acetylene jet and then applying compressed air through the apparatus, thus forming a spray of atomized metal.

Pistols for this purpose are a standard article and are used specifically for coating certain objects with low melting point metals, such as lead, tin, etc. This process is especially useful for large objects such as bridges and steel structures which cannot conveniently be dipped or handled by other processes.

It is quite possible to spray the surface of a plastic with one of these pistols and to obtain on it a conducting layer. Unfortunately, however, the layer is somewhat porous and discontinuous in nature and is not very suitable as a base for an electro deposit. In spraying a metal, this trouble can often be got over by preheating the metal surface, but this, unfortunately, is not possible in the case of a plastic, and, so far as the authors are aware, up to the time of writing, this difficulty has not been satisfactorily overcome and the layer produced by the apparatus described cannot be used for the majority of purposes.

(To be continued)

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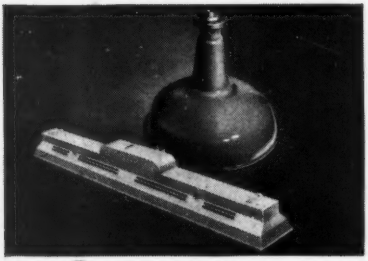

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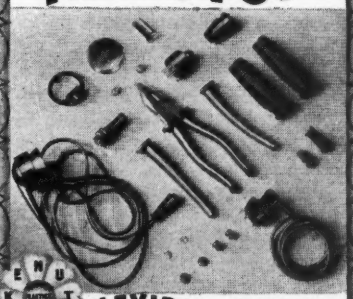

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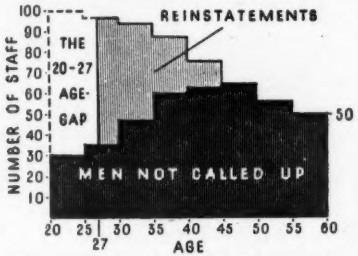

In this chart, the whole area shows the male administrative, executive and managerial staff of a typical engineering firm before the war, analysed by age-groups. The white portion is the present 20-27 gap that must be filled to restore the balance.

Yet, as the diagram shows, a gap remains in the 20-27 age-group — a gap that older men cannot fill. This hiatus in the ranks of salaried staff will prove dangerous to the future management of any business.

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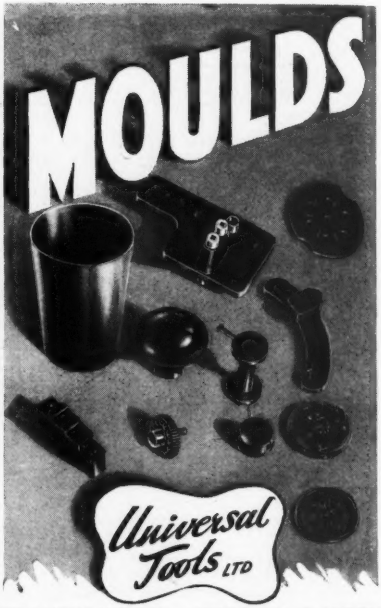

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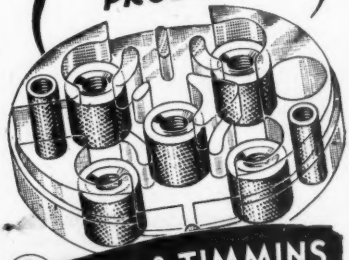

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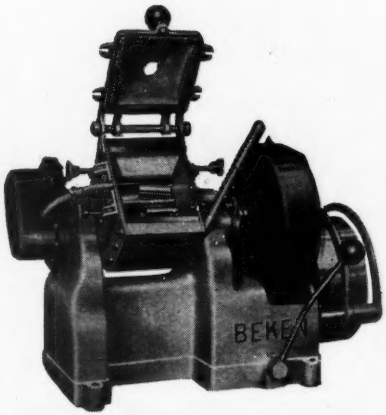

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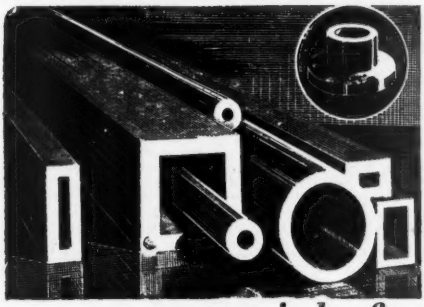

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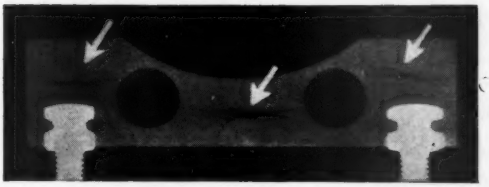

It was being used in the moulding industry over 10 years ago: and its value in developing a satisfactory moulding technique for plastic bodies with metal inserts was asserted by Kolb in the verdict "*Bakelite insulation into which are moulded metal parts provides a fertile field for X-ray examination*". (Radiography and Clinical Photography, vol. 10, 1934, May, p. 5).

Radiograph of a moulded Bakelite block with metal inserts: the arrows indicate porous regions, due to improper curing of the plastic.

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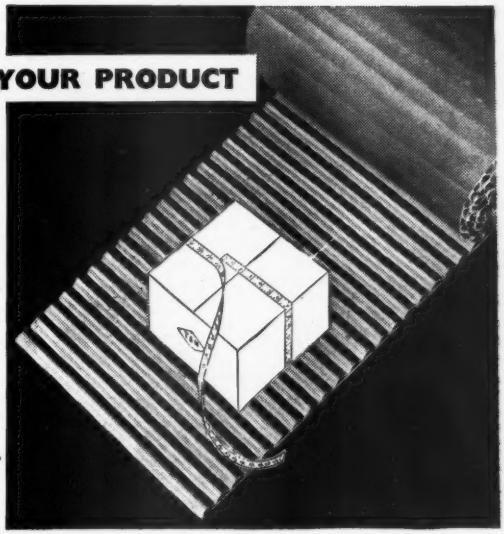

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Switzerland. Well-established Zürich engineer requires sole agency for British manufacturer of bakelite, etc., mouldings. Already representing several British electrical manufacturers. English references readily available. Box 4447, care of "Plastics." 112-22

BOOKS AND PUBLICATIONS

"Plastics for Electrical and Radio Engineers," by W. J. Tucker and R. S. Roberts, 12s. net, and "Plastics Mold Engineering," by J. H. Du Bois and W. I. Pribble, 45s. net. Recently published. The Technical Press, Ltd., Gloucester Road, Kingston Hill, Surrey. 113-7890

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Three Cambridge recording temperature controllers, dial type, range 50 to 300 degrees C., electric drive.
Cambridge recording pressure gauge, range 0-8 in. w.g., electric drive. Reed Brothers (Engineering), Ltd., Cuba Street, Millwall, E.14. 114-7894

Machinery, Tools and Plant (contd.)

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One No. 3 Manesty Tabletting Machine, partially dismantled and not quite complete, for disposal. Can be seen by appointment. Box 4461, care of "Plastics." 112-13

PATENTS

The owners of British Patents Nos. 555,832 and 557,345, also U.S. Patent No. 2,347,600, relating to devices for the mass-production moulding of small articles, invite offers for outright sale or licence. The processes are adaptable if desired to heatronic technique. Box 4442, care of "Plastics." 113-7889

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Repetition in Ebonite, Erinoid, etc. Capstan lathe work. Manzell, Temple Street, Rugby. 113-5069

Pulverizing and grading of raw materials. Dohm, Ltd., 167 Victoria Street, London, S.W.1. zzz-369

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Required, moulding capacity, preferably injection, for long runs up to three years. Apply, Box 36, care of "Plastics." zzz-376

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Glycerine. Advertiser requires regular supplies of glycerine for own consumption. Full particulars of surplus quantities and grades available to Box 3398, care of "Plastics." 112-7310

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Plastic firm with own moulds require moulding capacity up to 3-oz. shots. Reasonable runs. Good prices offered. Box 3798, care of " Plastics." 113-7654

Wanted to purchase, any quantities Bakelite, Urea and Phenol powders. Cash terms. Box 3812, care of " Plastics." 112-7655

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Firm near London with first-class connection in the wholesale perfumery, cosmetics and soap-making trade wish to contact well-placed manufacturers of plastic container for creation of new articles and with a view of securing sole agency for these particular trades only. Box 3841, care of " Plastics." 112-x9547

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Bakelite, ebonite and Erinoid rod and tube for sale. Box 4466, care of " Plastics." 112-9

Toolmakers and Designs (Coventry), Ltd., Brays Lane, Coventry. Phone 4051-2. Capacity available for design and manufacture of moulding tools. 112-5

Tufnol, Pascolin board, Bakelite paper board, for sale. Box 4463, care of " Plastics." 112-8

Perspex articles dyed in any colour, which adds considerably to the sales value of Perspex goods. We are specializing in this and invite trade inquiries. The Dorland Electric Co., Ltd., 38a Brompton Road, London, S.W.3. 112-3

Advertisers have many large orders to place for small plastic articles and novelties suitable for firms to distribute to customers as Christmas gifts. Will manufacturers please send particulars and quotations to A.B.C. Novelties and Inventions, Station Works, Westbrook, Margate. 112-1

Wanted—Perspex strip, 12 ins. by 1 in., in clear ⅛ in. or 3 mm., any quantity. Whiteman, 34 West Street, Bognor Regis. 112-8

Manufacturer has capacity available and would welcome inquiries for sheet metal detail manufacture; also Acetate, Perspex or Bakelite sheet forming and assembly work. Interested in long-run repetition orders. Burley and Cross, 312 City Way, Rochester. 112-x732

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Mould Designer with compression and injection experience required by Midland engineers. Salary £600. Suitable candidates sending, in confidence, full details of education and experience will be invited to interview. Box 4453, care of "Plastics." 112-19

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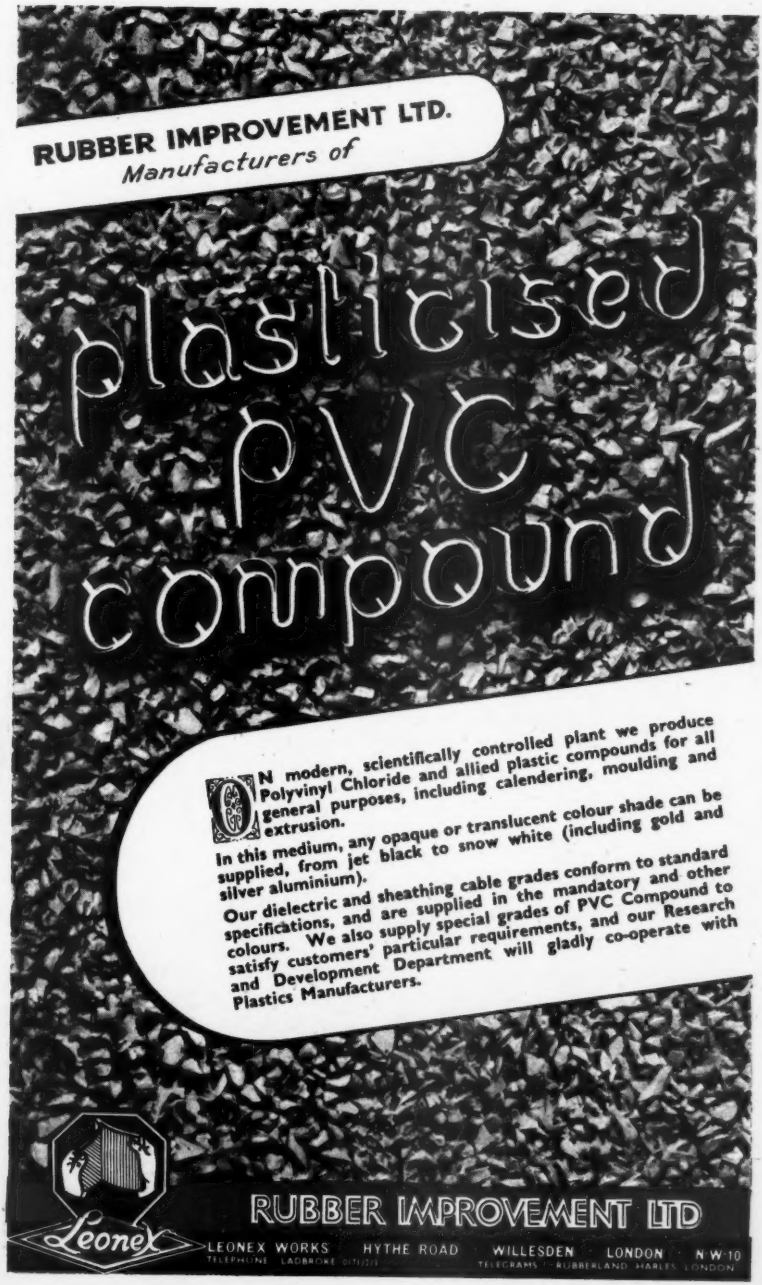
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